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ABSTRACT

These two manuals provide teacher and student materials for a 175-hour trade and industrial program for students in grades 10-12, composed of six 30-hour courses designed to provide students with minimum competencies for the construction industry. The curriculum guide is organized in eight sections. The first section describes how to use the curriculum guide, common essential elements for all occupational programs, essential elements for trade and industrial education, essential elements for the course, and a suggested sequence by section. The following six sections focus on each 6-week occupational area of instruction: air conditioning and refrigeration; bricklaying/stone masonry; carpentry; residential electrical trade; painting and decorating; and plumbing/pipefitting. The final section covers additional common essential elements. Each course contains an instructional delivery outline that lists the unit and/or topic titles keyed to the essential elements that apply, the instructional materials needed, and the recommended hours for each unit. Lesson plans are provided for each 6-week section. Appendixes include modification techniques for special populations, 45 references, answers to assignment sheets, and pre/posttests and answers. The student materials manual contains corresponding units to the curriculum guide. Each unit consists of a topic, unit objective, specific objective, information sheets, questions to answer, procedures or tasks, and (in some cases) references. (KC)

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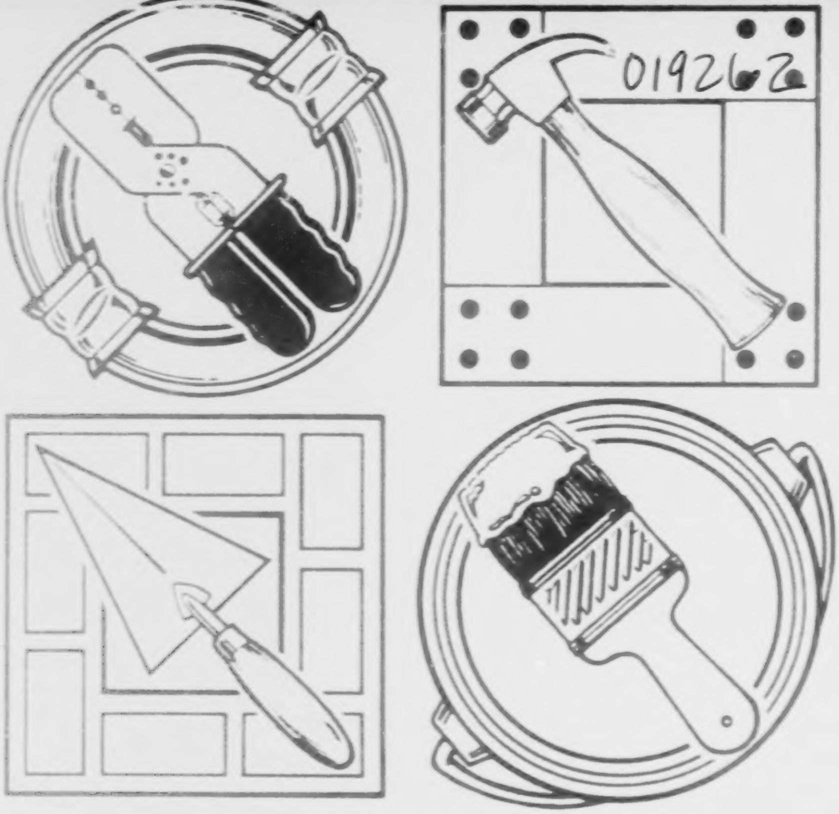

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CURRICULUM GUIDE

Introduction to Construction Careers Cluster

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CURRICULUM GUIDE
FOR
INTRODUCTION TO CONSTRUCTION CAREERS

DEVELOPED
BY
SHELIA I. GRANT-GOLD, ED.D.

OCCUPATIONAL CURRICULUM LABORATORY
TRADE AND INDUSTRIAL EDUCATION
EAST TEXAS STATE UNIVERSITY

IN COOPERATION WITH

TEXAS EDUCATION AGENCY
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PREFACE

The Occupational Curriculum Laboratory at East Texas State University is striving to provide needed curriculum materials to vocational instructors within the state.

The purpose of this publication is to assist instructors in improving instruction. As these materials are used, it is hoped that student performance will improve and that students will be better prepared to assume a role in a construction occupation.

Instructional materials in this publication are written in terms of student performance using measurable objectives. This approach augments the teaching-learning process. Criterion-referenced evaluation instructions are provided for a uniform measurement of student progress. In addition to evaluating recall information, teachers are encouraged to evaluate the other areas, including process and product.

Every effort has been made to make this publication basic, readable, and by all means, usable. Three vital areas of instruction (motivation, personalization, and localization) are not included in this publication; however, they should be capitalized on by the instructor. Only then will this publication really become a vital part of the teaching-learning process.

SECTION I

HOW TO USE

HOW TO USE THE CURRICULUM GUIDE
FOR
INTRODUCTION TO CONSTRUCTION CAREERS

The Introduction to Construction Careers cluster is a trade and industrial program for students in grades 10-12. It is a 175 hour (1 credit) total program, composed of six 30-hour courses representing the construction industry. The intent of the program is to provide students with minimal level occupational skills which are useful in the immediate future. The program will also provide students with a better understanding of the knowledge, skills and training needed to succeed in the construction industry.

Section I

This curriculum guide is intended to help instructors and administrators of the Introduction to Construction Careers cluster. The first section of the curriculum guide lists how to use the curriculum guide; common essential elements tor all vocational programs; essential elements for Trade and Industrial Education; essential elements for this course; and, a suggested sequence by section. The essential elements define the scope of the program. The suggested sequence by section list is intended to graphically show how the six areas of instruction may be applied. The following six sections of the curriculum guide focus on each six-week occupational area of instruction in detail. The final section covers additional common essential elements. Appendices appear at the end of this publication.

Section II through VII

The six occupational areas of instruction include: Air Conditioning and Refrigeration; Bricklaying/Stone Masonry; Carpentry; Residential Electrician Trade; Painting and Decorating; and Plumbing/Pipefitting.

Any six-week course within the construction cluster may be interchanged with any other six-week course within the cluster to meet local ISD scheduling needs. Each section of the curriculum guide represents the organization and use of the instructional materials available. The guide has been printed on loose leaf pages to make rearrangement of the instruction materials easier for the teacher.

Section VIII

The final section of this curriculum guide provides lesson plans covering common essential elements. These lessons may be used at any time within the course. Each instructor is encouraged to tailor the sequence of the lessons to meet individual classroom needs.

Essential Elements Page

Each section has the essential elements concerning the occupational area discussed in that section listed at the front. This is provided for easy reference when using the Instructional Delivery Outline (teaching sequence) which follows.

Instructional Delivery Outline

The first column, "Units and Topics of Instruction" lists the unit and/or topic titles. The second column lists the essential elements which apply to the instructional topic to be presented. Essential elements listed as "common" refer to 75.81 *Essential Elements Common to All Programs* as defined in the *State Board of Education Rules for Curriculum.*

The third column is used to key the instructional materials needed for teaching the topic of instruction. Topics keyed to Sections II through VIII refer to lessons which are included in this guide. Student packages are available for these lessons. Topics keyed to Section I refer to lessons which address essential elements which are common to trade and industrial programs.

The last column is listed with the unit title and has the recommended hours required to teach each of the units. Each occupational area will total 30 hours of instruction.

Lesson Plans

Each six-week section's lesson plans are provided in this publication. Lessons are formatted to serve as documentation for what is being taught in the class. Copies may be distributed to local administration officials.

Appendices

Appendices are to provide the teacher with additional sources of instructional material for use in the class. The appendices include: Teacher References and Resources; Student References and Resources; Audio-visual Material and Computer Software; and, Modification Techniques for Special Populations.

75.50 Vocational Education.

(a) The elements in this subsection are common to all vocational programs in this section offered at grades seven and eight and shall be included in each course at the appropriate level, unless otherwise indicated. They are described here to preclude repetition in each course. Every school offering vocational education at grades seven and eight shall provide courses which include the following essential elements:

(1) Leadership concepts and skills. The student shall be provided opportunities to:

(A) demonstrate skills, characteristics, and responsibilities of leaders and effective group members;

(B) demonstrate a knowledge of parliamentary procedure principles;

(C) plan and conduct leadership activities; and

(D) prepare for effective citizenship and for participation in our democratic society.

(2) Concepts and skills related to successful employment and/or postsecondary training. The student shall be provided opportunities to:

(A) identify employment opportunities and preparation requirement in the chosen field;

(B) identify effective methods to secure and terminate employment;

(C) demonstrate effective communication skills both oral and written and follow through on assigned tasks;

(D) demonstrate dependability and punctuality;

(E) demonstrate productive work habits and attitudes;

(F) understand the importance of taking pride in the quality of work performed;

(G) recognize the dignity in work;

(H) develop skills in planning and organizing work;

(I) apply required methods and sequences when performing tasks;

(J) apply principles of time management and work simplification when performing assigned tasks;

(K) identify ethical practices and responsibilities; and

(L) understand the importance of the application of organizational policies and procedures.

(3) Concepts and skills associated with entrepreneurship. The student shall be provided opportunities to:

- (A) identify opportunities for business ownership;
- (B) understand the risk and profit motive factor;
- (C) understand the elements and advantages of the free enterprise system; and
- (D) explain the role of small business in the free enterprise system.

(4) Concepts and skills related to safety and safe working conditions. The student shall be provided opportunities to identify and apply safe working practices to all training situations.

(5) Concepts and skills associated with human relations and personality development. The student shall be provided opportunities to:

- (A) understand the importance of maintaining good health and proper appearance for effective job performance;
- (B) understand oneself and others;
- (C) exercise self-control;
- (D) accept and use criticism;
- (E) recognize basic human relationships as they relate to business success; and
- (F) demonstrate characteristics for successful working relationships.

(6) Concepts and skills related to personal and business management. The student shall be provided opportunities to:

- (A) explain how management assists in reaching personal and family goals;
- (B) explain the management process;
- (C) describe the role of management in controlling stress;
- (D) identify and understand personal checking accounts;
- (E) identify and understand personal loan application processes;
- (F) identify and understand different financial institutions;
- (G) identify the role and functions of business management;
- (H) understand the lines of authority; and
- (I) identify effective supervisory techniques.

75.88 Trade and Industrial Education.

(a) The elements in this subsection are common to all trade and industrial courses unless otherwise indicated and shall be included in each course at the appropriate level. They are described here to preclude repetitions in each course. Every school offering trade and industrial education shall provide courses which include the following essential elements:

(1) Leadership concepts and skills. The student shall be provided opportunities to:

(A) demonstrate skills, characteristics, and responsibilities of leaders and effective group members;

(B) demonstrate a knowledge of parliamentary procedure principles;

(C) plan and conduct leadership activities; and

(D) prepare for effective citizenship and for participation in our democratic society.

(2) Concepts and skills related to successful employment and/or postsecondary training. The student shall be provided opportunities to:

(A) identify employment opportunities and preparation requirements in chosen fields;

(B) identify effective methods to secure and terminate employment;

(C) demonstrate effective communication skills both oral and written and follow through on assigned tasks;

(D) demonstrate dependability and punctuality;

(E) demonstrate productive work habits and attitudes;

(F) understand the importance of taking pride in the quality of work performed;

(G) recognize the dignity in work;

(H) develop skills in planning and organizing work;

(I) apply required methods in sequences when performing tasks;

(J) apply principles of time management and work simplification when performing assigned tasks;

(K) identify ethical practices and responsibilities; and

(L) understand the importance of the application of organizational policies and procedures.

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(C) understand the elements and advantages of the free enterprise system; and

(D) explain the role of small business in the free enterprise system.

(4) Concepts and skills related to safety and safe working conditions. The student shall be provided opportunities to identify and apply safe working practices to all training situations.

(5) Concepts and skills associated with human relations and personality development. The student shall be provided opportunities to:

(A) understand the importance of maintaining good health and proper appearance for effective job performance;

(B) understand oneself and others;

(C) exercise self-control;

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(6) Concepts and skills related to personal and business management. The student shall be provided opportunities to:

(A) explain how management assists in reaching personal and family goals;

(B) explain the management process;

(C) describe the role of management in controlling stress;

(D) identify and understand personal checking accounts;

(E) identify and understand personal loan application processes;

(F) identify and understand different financial institutions;

(G) identify the role and functions of business management;

(H) understand the lines of authority; and

(I) identify effective supervisory techniques.

(7) Concepts and skills associated with the specific occupation being taught. The student shall be provided opportunities to:

(A) understand the basic concepts of and develop proficiency in the occupational area for which instruction/training is provided;

(B) develop a fundamental understanding of mathematical principles and scientific procedures;

(C) understand terminology utilized;

(D) identify tools, equipment, and materials used; and

(E) develop and demonstrate appropriate techniques for the selection, use, maintenance, and storage of tools, equipment, and materials.

ESSENTIAL ELEMENTS
INTRODUCTION TO CONSTRUCTION CAREERS

(b) Introduction to construction careers(1/2-one unit) shall include the essential trade and industrial education elements and the following essential elements:

(1) Concepts and skills associated with air conditioning and refrigeration (approximately 30 hours). The student shall be provided opportunities to:

(A) understand basic electricity;

(B) be familiar with the effect of atmosphere conditions upon air conditioners;

(C) understand the operation of a compression system;

(D) be familiar with the operation of motors and electrical controls;

(E) understand air conditioning requirements for ventilation; and

(F) perform minor service and maintenance (clean coils, change filters, etc.).

(2) Concepts and skills associated with bricklaying/stone masonry (approximately 30 hours). The student shall be provided opportunities to:

(A) be familiar with various types of drawings and blueprints utilized by bricklayers/stone masons;

(B) understand the use of masonry ties and reinforcing bars;

(C) demonstrate cleaning procedures for tools and walls;

(D) be familiar with basic construction processes used in the trade;

(E) prepare, mix, and spread mortar; and

(F) construct a simple brick and block masonry wall.

(3) Concepts and skills associated with carpentry (approximately 30 hours). The student shall be provided opportunities to:

(A) demonstrate the ability to square, measure, and cut materials to specified dimensions with hand and power tools;

(B) build and set forms for a simple concrete slab or beam; and

(C) construct a cabinetry component.

(4) Concepts and skills associated with the residential electrician trade (approximately 30 hours). The student shall be provided opportunities to:

(A) identify sources of electrical power;

(B) become familiar with uses of electrical power (residential, industrial);

(C) understand basic electrical theory;

(D) wire light and single pole switch circuit; and

(E) practice simple electrical troubleshooting.

(5) Concepts and skills associated with painting and decorating (approximately 30 hours). The student shall be provided opportunities to:

(A) be familar with the basic of color, including psychological impact, selection, and styling;

(B) understand painting and cleanup procedures;

(C) prepare a surface for painting;

(D) paint, lacquer, or varnish wood, metal, or synthetic surfaces;

(E) become familar with the fundamental processes of drywall finishing; and

(F) demonstrate basic techniques of selection of materials, estimation of materials, preparation of surfaces, and paper hanging.

(6) Concepts and skills associated with plumbing/pipefitting (approximately 30 hours). The student shall be provided opportunities to:

(A) cut, thread, and bend pipe according to instructions;

(B) sweat a joint; and

(C) join piping by at least one other method (glue, couple, weld, etc.).

SUGGESTED SEQUENCE BY SECTION

The sections (occupational areas) in this guide appear in the same sequence as the essential elements. This does not mean the occupational areas must be taught in that order.

Each section is designed to stand alone. No prerequisite information is required of the student for any one of the sections.

This course may be taught in any one of the possible sequences. The best order to present the six-week sections (courses) will depend on the experience of the teacher and the needs of the local independent school district.

The sequence listed below is suggested by the staff who developed the material. The teacher and/or the administration is responsible for determining and documenting the best sequence of presenting the sections within the course.

Order	Section	Occupational Area
1.	II.	Air Conditioning and Refrigeration
2.	III.	Bricklaying/Stone Masonry
3.	IV.	Carpentry
4.	V.	Residential Electrician Trade
5.	VI.	Painting and Decorating
6.	VII.	Plumbing/Pipefitting

SECTION II

AIR CONDITIONING AND REFRIGERATION

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT:	Safety
TOPIC:	General Job Safety
ESSENTIAL ELEMENT(S):	Common (4); T&I (4)
TYPE OF LESSON:	Cognitive, Psychomotor
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to: 1. describe the procedures to follow for proper ladder and scaffolding safety; 2. explain how relations with other employees can affect your safety; 3. discuss the importance of safe attitudes on the job; 4. list the steps to take when lifting heavy weights; and 5. describe the kind of clothing that should be worn on the job.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Drawings or pictures of ladders and scaffolds
REFERENCES:	Air Conditioning and Refrigeration Mechanic Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet and Assignment Sheet/General Job Safety/Job Sheet/Setting Up a Leaning Ladder

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus student's attention on the importance of safety. Provide examples of injuries which occurred due to failure to follow safety precautions. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why safety is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/General Job Safety as a guide, present safety information. Discuss the information provided; ask questions requiring individual and group responses.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/General Job Safety as independent practice. Use JS/ Setting Up a Leaning Ladder as application of information.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of ICC/AS/General Safety.

SUMMARY/CLOSURE

In this lesson you have learned the importance of safety practices while using ladders and scaffolding. Not only is it important that you observe safe working practices but also it is important that others practice safety. Safe attitudes play an important part in working safely. Safety involves learning to lift and carry weight correctly. Also the type of clothing you wear may affect your safety.

THE NEXT LESSON IS: Electrical Safety

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT:	Safety
TOPIC:	Electrical Safety
ESSENTIAL ELEMENT(S):	Common (4); T&I (4)
TYPE OF LESSON:	Cognitive, Psychomotor
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to: 1. explain how to work on energized electrical equipment without receiving a shock; and 2. tell what to do when a shock victim is discovered near electrical equipment.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Air Conditioning and Refrigeration Mechanic Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Electrical Safety/Job Sheet/Working With Energized Circuits

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Write on the board, ONE AMP OF ELECTRICAL CURRENT FOR ONE SECOND OF CONTACT CAN CAUSE DEATH!! By the end of the lesson, you will be able to discuss electrical safety and how to protect yourself and others.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Electrical Safety, discuss the SPECIAL need for safety precautions when working with electrical equipment. Note that failure to follow safety rules in some areas of the construction trade may result in injury; however, failure to observe safety rules when dealing with electricity may result in death.

STUDENT ACTIVITIES (APPLICATION)
Utilize classroom discussion to reinforce safety rules in regard to electrical safety. Use AS/Electrical Safety to provide students an opportunity to demonstrate a knowledge of electrical safety. Use JS/Working With Energized Circuits as application of information.

EVALUATION/VERIFICATION
AS/Electrical Safety may be used as a means of evaluating learning.

SUMMARY/CLOSURE

Review safety precautions which should be followed when working with electricity. Have students discuss what should be done in the case of electrical shock. Note that preventing yourself or another person from becoming a shock victim in the first place is much better.

THE NEXT LESSON IS: Hand Tool and Power Tool Safety

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT:	Safety
TOPIC:	Hand Tool and Power Tool Safety
ESSENTIAL ELEMENT(S):	Common (4); T&I (4)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to: 1. tell how common hand tools can be dangerous if not properly maintained; 2. discuss the importance of keeping all cutting tools sharp; 3. explain how the proper maintenance of power tools can prevent accidents; 4. explain how operating power tools correctly will result in fewer accidents; and 5. discuss proper storing procedures for sharp tools.

TOOLS AND EQUIPMENT:	Select four to five air conditioning and refrigeration tools for display.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Use classroom tool storage area as an example of how tools should be stored.
REFERENCES:	Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Hand Tool and Power Tool Safety

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In this lesson you will learn a few of the reasons why it is important to use safety precautions while working with hand and power tools in air conditioning and refrigeration. By the end of the lesson, you will be able to discuss why safety is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Hand Tool and Power Tool Safety as a guide, discuss safety factors in regard to the use of hand and power tools. Briefly show students a few of the types of tools used in air conditioning and refrigeration and where they should be stored.

STUDENT ACTIVITIES (APPLICATION)

Provide students an opportunity to ask questions about tool safety. Use AS/Hand Tool and Power Tool Safety to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done on an informal basis through the use of group and individual questions.

SUMMARY/CLOSURE

Review the main points of the lesson, stressing the individual student's responsibility to use safety precautions.

THE NEXT LESSON IS: Customer Relations

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Careers in Air Conditioning and Refrigeration

TOPIC: Customer Relations

ESSENTIAL ELEMENT(S): Common (2) C-G, K-L; (5) A-F, T&I (2) C-G, K-L; (5) A-F

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. tell why it is important to be familiar with your company policies;
2. give the personal characteristics that are important in working with the customers;
3. explain what course of action to follow when dealing with an irate customer; and
4. explain how an understanding of customer attitudes can be beneficial to you.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Customer Relations

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Give examples of rude sales clerks or employees, such as employees who knew very little about the business where they worked, etc. Discuss why these things bothered you; ask class for input.
By the end of the lesson, you will be able to discuss the importance of good customer relations.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Customer Relations as a guide, discuss the importance of maintaining good customer relations. Ask individual and group response questions to check for understanding.

STUDENT ACTIVITIES (APPLICATION)

Have students write one paragraph about why they feel good customer relations will be important to them on the job.

EVALUATION/VERIFICATION

Use AS/Customer Relations to verify learning.

SUMMARY/CLOSURE

Review points of importance, ie. loyal to employer, initiative, honesty, attitudes, habits.

THE NEXT LESSON IS: Occupational Outlook

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT:	Introduction to Careers in Air Conditioning and Refrigeration
TOPIC:	Occupational Outlook
ESSENTIAL ELEMENT(S):	Common (2) A, C, I, J; T&I (2) A, C, I, J
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to: 1. discuss the type of work air conditioning and refrigeration mechanics perform; 2. list four occupational hazards in the air conditioning and refrigeration trade; 3. tell where the majority of these mechanics find employment; 4. give the beginning qualifications for helpers or apprentices; and 5. give the occupational outlook for air conditioning and refrigeration mechanics through the 1990's.

TOOLS AND EQUIPMENT:	No special tools or equipment are are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Classified ads from newspapers, outside speaker from air conditioning and refrigeration
REFERENCES:	Air Conditioning and Refrigeration Mechanic Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Occupational Outlook

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Provide students with the classified section of the newspaper. (Have students share if there are too few copies.) Have each student find one job opening and list the requirements for that job. By the end of the lesson, you will be able to discuss the types of work done in air conditioning and refrigeration and the job outlook.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Occupational Outlook as a guide, discuss the occupational outlook for air conditioning and refrigeration. Usepersonal experiences or information about others to reinforce this area of instruction. You may wish to invite an individual working is the area of air conditioning and refrigeration to visit your class.

STUDENT ACTIVITIES (APPLICATION)

Have students compete AS/Occupational Outlook.

EVALUATION/VERIFICATION
Verify learning through the use of class discussion and/or questions and answers.

SUMMARY/CLOSURE
Stress the importance of finding out as much as you can about a career before you make an occupational choice.

THE NEXT LESSON IS: Understanding Basic Electricity

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT:	Introduction to Air Conditioning and Refrigeration
TOPIC:	Understanding Basic Electricity
ESSENTIAL ELEMENT(S):	T&I (7) A-C; Core (1) A
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of basic electricity.

TOOLS AND EQUIPMENT:	Display equipment which will illustrate the use of direct-current (DC) and alternating-current (AC).
MATERIALS:	No special materials are required.
TEACHING AIDS:	TMs of the figures shown in Student Information Sheet
REFERENCES:	Air Conditioning and Refrigeration Mechanic Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Understanding Basic Electricity

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Use equipment set up prior to class to demonstrate direct-current and alternating-current. Allow students time to look closely at display. By the end of the lesson, you will be able to discuss the fundamentals of basic electricity.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Follow information provided in SIS/Understanding Basic Electricity. Discuss and demonstrate how direct-current flows and how alternating-current flows.

STUDENT ACTIVITIES (APPLICATION)

Allow students to turn display equipment on and off.

EVALUATION/VERIFICATION

Use AS/Understanding Basic Electricity to evaluate learning.

SUMMARY/CLOSURE

Review the differences between (DC) and (AC). Review why each has special uses.

THE NEXT LESSON IS: Hand Tools

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Air Conditioning and Refrigeration
TOPIC: Hand Tools
ESSENTIAL ELEMENT(S): T&I (7) D
TYPE OF LESSON: Cognitive, Psychomotor
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify air conditioning and refrigeration tools.

TOOLS AND EQUIPMENT: Display of tools selected from those shown on SIS/Hand Tools

MATERIALS: No special materials are required.

TEACHING AIDS: TMs of various tools

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Hand Tools/Job Sheet/Using Hand Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Prepare display of hand tools in the classroom. Allow students to examine tools prior to beginning the lesson. By the end of the lesson, you will be able to identify hand tools used in air conditioning and refrigeration.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Hand Tools as a guide, discuss the various types of hand tools used in air conditioning and refrigeration.

STUDENT ACTIVITIES (APPLICATION)

Using the TMs of hand tools, have students identify various tools.

EVALUATION/VERIFICATION

Use AS/Hand Tools to check for learning. Use JS/Using Hand Tools to verify learning.

SUMMARY/CLOSURE

Review as many of the tools as time allows. Hold up the tools or pictures of the tools and have students identify each one.

THE NEXT LESSON IS: Refrigerant Tools and Equipment

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Refrigerant Tools and Equipment

ESSENTIAL ELEMENT(S): T&I (7) A, C, D, E

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify refrigerant tools and equipment.

TOOLS AND EQUIPMENT: Prepare a display of specialized refrigerant tools and equipment.

MATERIALS: No special materials are required.

TEACHING AIDS: TMs of tools and equipment

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Refrigerant Tools and Equipment

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Pass out a picture of an electronic leak detector and have students guess what it is used for. By the end of the lesson, you will be able to identify various types of tools and equipment used when working with refrigerants.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Refrigerant Tools and Equipment as a guide, introduce students to various types of tools and equipment used when working with refrigerants. Explain that many of the tools are specialized and require a great deal of knowledge and care. Provide students an opportunity to ask questions about how these tools and equipment are used.

STUDENT ACTIVITIES (APPLICATION)

Have students complete AS/Refrigerant Tools and Equipment.

EVALUATION/VERIFICATION

Check each student's work on AS/Refrigerant Tools and Equipment to verify learning.

SUMMARY/CLOSURE

Review the tools and equipment covered in the lesson. Point out uses for each tool.

THE NEXT LESSON IS: Materials Used In Air Conditioning and Refrigeration

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Materials Used In Air Conditioning and Refrigeration

ESSENTIAL ELEMENT(S): T&I (7) A, C, D, E

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify materials used in air conditioning and refrigeration work.

TOOLS AND EQUIPMENT: Tools for display

MATERIALS: Materials for display

TEACHING AIDS: TMs showing tools and materials discussed in lesson

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Materials Used in Air Conditioning and Refrigeration

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Hold up various types of materials and have students try to identify what they are and what they are used for. By the end of the lesson, you will be able to identify materials used in air conditioning and refrigeration.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Following SIS/Materials Used In Air Conditioning and Refrigeration, discuss the types of materials used in air conditioning and refrigeration. Give examples of how materials are used.

STUDENT ACTIVITIES (APPLICATION)

Have students complete AS/Materials Used In Air Conditioning and Refrigeration.

EVALUATION/VERIFICATION

Check student work in order to verify learning.

SUMMARY/CLOSURE

Review one or two types of materials from the different groups. Have students give name and use.

THE NEXT LESSON IS: Understanding the Basic Concepts of Refrigeration

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Air Conditioning and Refrigeration
TOPIC: Understanding the Basic Concepts of Refrigeration
ESSENTIAL ELEMENT(S): T&I (7) A-C
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate a knowledge of the basic concepts of refrigeration.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: One candle, two small plates, ice-cubes

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Understanding the Basic Concepts of Refrigeration

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Light a candle then blow it out. Next place an ice-cube in a plate. Ask students which process is used in air conditioning and refrigeration. By the end of the lesson, you will be familiar with the basic concepts of refrigeration.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Understanding the Basic Concepts of Refrigeration as a guide, discuss the various concepts of refrigeration. Show examples when possible.

STUDENT ACTIVITIES (APPLICATION)
Have students complete AS/Understanding the Basic Concepts of Refrigeration.

EVALUATION/VERIFICATION
Score AS/Understanding the Basic Concepts of Refrigeration in order to verify learning.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Effects of Atmospheric Conditions on Air Conditioners

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT:	Fundamentals of Air Conditioning and Refrigeration
TOPIC:	Effects of Atmospheric Conditions on Air Conditioners
ESSENTIAL ELEMENT(S):	T&I (7) A, C; Core (1) B
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be familiar with the effects of atmospheric conditions upon air conditioners.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Air Conditioning and Refrigeration Mechanic Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Effects of Atmospheric Conditions on Air Conditioners.

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Before beginning to work with air conditioners, you must first learn how atmospheric conditions affect you the individual. By the end of the lesson, you will be familiar with the effects of atmospheric conditions on air conditioners.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Effects of Atmospheric Conditions on Air Conditioners as a guide, discuss how atmospheric conditions affect individuals and how they affect air conditioners.

STUDENT ACTIVITIES (APPLICATION)
Have students complete AS/Effects of Atmospheric Conditions on Air Conditioners.

EVALUATION/VERIFICATION
Score AS/Effects of Atmospheric Conditions on Air Conditioners in order to verify learning.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: How Does the Compression System Operate?

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT:	Fundamentals of Air Conditioning and Refrigeration
TOPIC:	How Does the Compression System Operate?
ESSENTIAL ELEMENT(S):	T&I (7) A, C; Core (1) C
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of the operations of a compression system.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Make a TM of Figure one, Basic parts of a compressor; do not include the title of the figure.
REFERENCES:	Air Conditioning and Refrigeration Mechanic Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/How Does the Compression System Operate?

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Show the TM (make sure the label BASIC PARTS OF A COMPRESSOR does not show) to the class. Give students the opportunity to guess what the picture is a part of. By the end of the lesson, you will have a basic understanding of how the compression system operates.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/How Does the Compression System Operate? as a guide, discuss how compression systems operate. Discuss the different types of compressors which may be used.

STUDENT ACTIVITIES (APPLICATION)

Have students complete AS/How Does the Compression System Operate?

EVALUATION/VERIFICATION

Score AS/How Does the Compression System Operate? in order to verify learning.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: How Do Electric Motors Operate?

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: How Do Electric Motors Operate?

ESSENTIAL ELEMENT(S): T&I (7) A, C; Core (1) D

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be familiar with the operation of motors.

TOOLS AND EQUIPMENT: Various types of electrical motors if available

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of Figures one and two.

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/How Do Electric Motors Operate?

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Have one or more of the electric motors operating when the students enter the room. Give students the opportunity to examine the motors before beginning class. By the end of the lesson, you will be familiar with how electric motors operate.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/How Do Electric Motors Operate? as a guide, discuss how electric motors operate. Use the display of electric motors as examples while presenting the material.

STUDENT ACTIVITIES (APPLICATION)

Have students complete AS/How Do Electric Motors Operate?

EVALUATION/VERIFICATION

Score AS/How Do Electric Motors Operate? in order to verify learning.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: How Do Electric Controls Operate?

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Fundamentals of Air Conditioning and Refrigeration
TOPIC: How Do Electric Controls Operate?
ESSENTIAL ELEMENT(S): T&I (7) A, C; Core (1) D
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be familiar with the operation of electric controls.

TOOLS AND EQUIPMENT: Display of electrical motors with various types of controls if available

MATERIALS: No special materials are required.

TEACHING AIDS: Make a TM of Figure one.

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/How Do Electric Controls Operate?

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Quickly review the previous lesson on electric motors. Discuss that today they will be learning about how electrical controls operate these motors. By the end of the lesson, you will be familiar with the operation of electrical controls.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/How Do Electrical Controls Operate? as a guide, discuss how the electrical controls on motors operate. Use the display of electric motors as examples while presenting the material.

STUDENT ACTIVITIES (APPLICATION)
Have students complete AS/How Do Electrical Controls Operate?

EVALUATION/VERIFICATION
Score AS/How Do Electrical Controls Operate? in order to verify learning.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Air Conditioning Requirements for Ventilation

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Fundamentals of Air Conditioning and Refrigeration
TOPIC: Air Conditioning Requirements for Ventilation
ESSENTIAL ELEMENT(S): T&I (7) A, C; Core (1) E
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. explain how the pressure system in a central air conditioning unit causes the air to circulate through a complete cycle;
2. tell why modern buildings must have a controlled fresh-air intake; and
3. tell what considerations must be taken into account regarding the location of outlets from an air duct system.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of Figures one and two.

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Student Information Sheet/Assignment Sheet/Air Conditioning Requirements for Ventilation

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Quickly review the previous lesson on how the compression system operates. Discuss that today they will be learning about how heat travels in much the same manner as refrigerant moving through a refrigeration system. By the end of the lesson, you will be familiar with the ventilation requirements for air conditioning.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Air Conditioning Requirements for Ventilation as a guide, discuss the importance of knowing the ventilation requirements for air conditioning when planning an air conditioning system.

STUDENT ACTIVITIES (APPLICATION)

Have students complete AS/Air Conditioning Requirements for Ventilation.

EVALUATION/VERIFICATION

Score AS/Air Conditioning Requirements for Ventilation in order to verify learning.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Cleaning Condenser Coils

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Working in Air Conditioning and Refrigeration

TOPIC: Cleaning Condenser Coils

ESSENTIAL ELEMENT(S): Common (2) H-J; T&I (2) H-J; (7) A, C, D, E; Core (1) F

TYPE OF LESSON: Psychomotor, Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor service and maintenance in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will demonstrate the ability to clean condenser coils on an air conditioner.

TOOLS AND EQUIPMENT: Water/garden hose, stiff bristled broom, bucket, portable air tank, and condenser coils

MATERIALS: Soap and water

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Job Sheet/Cleaning Condenser Coils

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In previous lessons you have learned about air conditioning and refrigeration systems and how they operate. By the end of the lesson, you will have demonstrated the ability to clean the condenser coils on an air conditioner.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Review the general instructions given for cleaning condenser coils. Move about the room to assist and give direction as needed.

STUDENT ACTIVITIES (APPLICATION)

Have students complete JS/Cleaning Condenser Coils. (It may be necessary to have students take turns in completing this exercise depending on the availability of equipment.)

EVALUATION/VERIFICATION

Check student's performance on cleaning condenser coils in order to verify learning.

SUMMARY/CLOSURE

Review the main steps taken in cleaning the condenser coils.

THE NEXT LESSON IS: Replacing the Air Filter

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Working in Air Conditioning and Refrigeration
TOPIC: Replacing the Air Filter
ESSENTIAL ELEMENT(S): Common (2) H-J; T&I (2) H-J; (7) A, C, D, E; Core (1) F
TYPE OF LESSON: Psychomotor, Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor service and maintenance in air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will demonstrate the ability to correctly replace the air filter in an air conditioning system.

TOOLS AND EQUIPMENT: Air conditioner

MATERIALS: Air filter for air conditioner

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Job Sheet/Replacing the Air Filter

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In previous lessons you have learned about air conditioning and refrigeration systems and how they operate. By the end of the lesson, you will have demonstrated the ability to correctly replace the air filter in an air conditioner.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Review the general instructions given for replacing an air conditioner filter. Move about the room to assist and give direction as needed.

STUDENT ACTIVITIES (APPLICATION)

Have students complete JS/Replacing the Air Filter. (It may be necessary to have students take turns in completing this exercise depending on the availability of equipment.)

EVALUATION/VERIFICATION

Check student's performance on replacing the air filter in the air conditioner.

SUMMARY/CLOSURE

Review the main steps taken in replacing the air filter.

THE NEXT LESSON IS: Lubricating Components of an Air Conditioning System

LESSON PLAN

AIR CONDITIONING AND REFRIGERATION

UNIT: Working in Air Conditioning and Refrigeration

TOPIC: Lubricating Components of an Air Conditioning System

ESSENTIAL ELEMENT(S): Common (2) H-J; T&I (2) H-J; (7) A, C, D, E; Core (1) F

TYPE OF LESSON: Psychomotor, Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor service and maintenance in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will demonstrate the ability to correctly lubricate the components of an air conditioning system.

TOOLS AND EQUIPMENT: Air conditioner, small oil can

MATERIALS: Rags, SAE 30-weight oil

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Air Conditioning and Refrigeration Mechanic
Introduction to Construction Careers/Air Conditioning and Refrigeration/Job Sheet/Lubricating Components of an Air Conditioning System

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In previous lessons you have learned about air conditioning and refrigeration systems and how they operate. By the end of the lesson, you will have demonstrated the ability to correctly lubricate the components of an air conditioning system.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Review the general instructions given for lubricating the components of an air conditioning system. Move about the room to give direction or assistance as needed.

STUDENT ACTIVITIES (APPLICATION)

Have students complete JS/Lubricating the Components of an Air Conditioning System. It may be necessary to have students take turns in completing this exercise depending on the availability of equipment.

EVALUATION/VERIFICATION

Check student's performance on replacing the air filter in the air conditioner.

SUMMARY/CLOSURE

Review the main steps taken in replacing the air filter.

THE NEXT LESSON IS: We will be starting on a new section of construction careers.

BRICKLAYING
STONE MASONRY

SECTION III

BRICKLAYING/STONE MASONRY

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Safety
TOPIC: General Safety
ESSENTIAL ELEMENT(S): Common (4); T&I (4)
TYPE OF LESSON: Cognitive, Psychomotor
UNIT OBJECTIVE: After completing this unit, the student will bet able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. list general requirements for good housekeeping;
2. discuss personal protective devices to use in masonry trades; and
3. describe safety measures to use when using ladders and scaffolds.

TOOLS AND EQUIPMENT: Display of various articles of protective clothing

MATERIALS: No special materials are required.

TEACHING AIDS: Drawings or pictures of ladders and scaffolds

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying/Stone Masonry/Student Information Sheet and Assignment Sheet/General Safety/Job Sheet/Using Eye Protection

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus student's attention on the importance of safety. Provide examples of injuries which occurred due to failure to follow safety precautions. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why safety is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/General Safety as a guide, present safety information. Discuss the information provided; ask questions requiring individual and group responses.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/General Safety as independent practice. Use JS/Using Eye Protection as application of information.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of ICC/AS/General Safety.

SUMMARY/CLOSURE

In this lesson you have learned the importance of safety practices while using ladders and scaffolding. Not only is it important that you observe safe working practices but also it is important that others practice safety. Safe attitudes play an important part in working safely. The type of clothing you wear may affect your safety.

THE NEXT LESSON IS: Handling and Storage of Materials

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Safety
TOPIC: Handling and Storage of Materials
ESSENTIAL ELEMENT(S): Common (4); T&I (4); (7) E
TYPE OF LESSON: Cognitive, Psychomotor
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. explain the precautions to take when handling materials by hand;
2. list the steps for proper lifting; and
3. discuss the methods of storing tools and materials.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Tool storage area of classroom, TM showing proper lifting position

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying/Stone Masonry/Student Information Sheet and Assignment Sheet/Handling and Storage of Materials/Job Sheet/Using Correct Lifting Procedures

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus student's attention on the importance of safety. Provide examples of injuries which occurred due to failure to follow safety precautions. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why safety is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Handling and Storage of Materials as a guide, present safety information regarding storing and handling materials and tools. Discuss the steps to use in lifting weight correctly.

STUDENT ACTIVITIES (APPLICATION)

Have students copy the steps to use in lifting weight correctly on a piece of paper. Use SIS/Handling and Storage of Materials as independent practice. Use JS/Using Correct Lifting Procedures as application of information.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of AS/Handling and Storage of Material.

SUMMARY/CLOSURE

In this lesson you have learned the importance of safety practices in storing tools and materials. (Have students list the steps for correctly lifting weight.)

THE NEXT LESSON IS: Hand and Power Tool Safety

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Safety
TOPIC: Hand Tool and Power Tool Safety
ESSENTIAL ELEMENT(S): Common (4); T&I (4)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. list precautions to take when using sharp-pointed hand tools;
2. discuss saw and blade safety;
3. describe safety to observe when using pounding tools; and
4. give safety rules concerning power equipment.

TOOLS AND EQUIPMENT: Select four to five bricklaying/stone masonry tools for display.

MATERIALS: No special materials are required.

TEACHING AIDS: Use classroom tool storage area as an example of how tools should be stored.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/Assignment Sheet/Hand Tool and Power Tool Safety

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
In this lesson you will learn a few of the reasons why it is important to use safety precautions while working with hand and power tools in bricklaying/stone masonry. By the end of the lesson, you will be able to discuss why safety is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Hand Tool and Power Tool Safety as a guide, discuss safety factors in regard to the use of hand and power tools. Briefly show students a few of the types of tools used in bricklaying/stone masonry and where they should be stored.

STUDENT ACTIVITIES (APPLICATION)
Provide students an opportunity to ask questions about tool safety. Use AS/Hand Tool and Power Tool Safety to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done on an informal basis through the use of group and individual questions.

SUMMARY/CLOSURE

Review the main points of the lesson, stressing the individual student's responsibility to use safety precautions.

THE NEXT LESSON IS: Careers in the Masonry Field

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT:	Introduction to Careers in Bricklaying/Stone Masonry
TOPIC:	Careers in the Masonry Field
ESSENTIAL ELEMENT(S):	Common (2) A, C, I, J; T&I (2) A, C, I, J
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to: 1. describe various types of jobs performed by bricklayers and stonemasons; 2. name locations where masonry workers normally find employment; 3. list the requirements for apprenticeship in the masonry trades; and 4. discuss the advantages and disadvantages of masonry as a trade.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Classified ads from newspapers, outside speaker from bricklaying/stone masonry
REFERENCES:	Bricklayer and Stonemason Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/Assignment Sheet/Careers in the Masonry Field

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Provide students with the classified section of the newspaper. (Have students share if there are too few copies.) Have each student find one job opening and list the requirements for that job. By the end of the lesson, you will be able to discuss the types of careers available in the masonry field.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Careers in the Masonry Field as a guide, discuss the types of work performed in the masonry field. Use personal experiences or have an outside speaker from the bricklaying/stone masonry field speak.

STUDENT ACTIVITIES (APPLICATION)

Provide students an opportunity to ask questions about careers. Use AS/Careers in the Masonry Field to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done on an informal basis through the use of group and individual questions.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Setting Up a Masonry Business

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Being Your Own Boss

TOPIC: Setting Up a Masonry Business

ESSENTIAL ELEMENT(S): Common (2) A; (3) A, B, D; T&I (2) A; (3) A, B, D

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. recognize the opportunities for business ownership;
2. identify entry-level procedures, planning processes, and terms needed to open a business; and
3. develop an understanding of the role of small business in the free enterprise system.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Invite an individual from your local community who has started his or her own bricklaying/stone masonry business to speak.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/Assignment Sheet/Setting Up a Masonry Business

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Start the lesson by discussing the possibilities of business ownership in the area of bricklaying/stone masonry. By the end of the lesson, you will be able to discuss the possibilities of owning your own business in bricklaying/stone masonry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Introduce the guest speaker. Have him or her discuss how he or she got started in his or her business. Provide the students an opportunity to ask questions. Use SIS/Setting Up a Masonry Business as an information handout.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Setting Up a Masonry Business to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done on an informal basis through the use of group and individual questions.

SUMMARY/CLOSURE

Review the main points of the lesson, stressing the opportunities available in business ownership.

THE NEXT LESSON IS: Human Relations in a Business

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Being Your Own Boss

TOPIC: Human Relations in a Business

ESSENTIAL ELEMENT(S): Common (3) A, B; (5) A, B, E; (6) G; T&I (3) A, B; (5) A, B, E; (6) G

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. discuss factors involved in the selection of personnel;
2. explain how to effectively train new employees; and
3. discuss the effects of good human relations and morale upon an employee's production.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Invite an individual from your local community who has started his or her own bricklaying/stone masonry business to speak.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/Assignment Sheet/Human Relations in a Business

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Review the lesson on Setting Up a Masonry Business. Introduce the speaker. Instruct the students to write down important facts regarding human relations in business. By the end of the lesson, you will be able to discuss the importance of human relations in business.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

As the guest speaker is talking, have students write down important factors regarding human relations in business. Prompt students to ask questions. Use SIS/Human Relations in a Business as an information handout.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Human Relations in a Business to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done on an informal basis through the use of group and individual questions.

SUMMARY/CLOSURE

Review the main points of the lesson, stressing the opportunities available in business ownership and the importance of good human relations.

THE NEXT LESSON IS: Trowels, Hammers, Chisels and Mixing Tools

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Trowels, Hammers, Chisels, and Mixing Tools

ESSENTIAL ELEMENT(S): T&I (7) A, D, E

TYPE OF LESSON: Cognitive, Psychomotor

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify trowels, hammers, chisels and mixing tools used in bricklaying/stone masonry.

TOOLS AND EQUIPMENT: Display of tools used in bricklaying/stone masonry

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs to show tools not available in your classroom.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/Assignment Sheet/Trowels, Hammers, Chisels, and Mixing Tools/Job Sheet/Using Bricklaying/Stone Masonry Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Hold up several of the tools or pictures of tools used in bricklaying/stone masonry. Have students try to identify each tool and tell what it is used for. By the end of the lesson, you will be able to identify tools used in bricklaying/stone masonry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Trowels, Hammers, Chisels, and Mixing Tools as a guide, discuss the various types of tools used in bricklaying/stone masonry.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Trowels, Hammers, Chisels, and Mixing Tools to reinforce this area of instruction. Use JS/Using Bricklaying/Stone Masonry Tools as application of information.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Close by having students name tools as you hold up tools or pictures of tools.

THE NEXT LESSON IS: Measuring and Leveling Tools

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT:	Introduction to Bricklaying/Stone Masonry
TOPIC:	Measuring and Leveling Tools
ESSENTIAL ELEMENT(S):	T&I (7) A, D, E
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify measuring and leveling tools used in bricklaying/stone masonry.

TOOLS AND EQUIPMENT:	Display of tools used in bricklaying/stone masonry
MATERIALS:	No special materials are required.
TEACHING AIDS:	Make TMs to show tools not available in your classroom.
REFERENCES:	Bricklayer and Stonemason Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/Assignment Sheet/Measuring and Leveling Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Hold up several of the tools or pictures of tools used in bricklaying/stone masonry. Have students try to identify each tool and tell what it is used for. By the end of the lesson, you will be able to identify measuring and leveling tools used in bricklaying/stone masonry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Measuring and Leveling Tools as a guide, discuss the various types of tools used in bricklaying/stone masonry.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Measuring and Leveling Tools to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Close by having students name tools as you hold up tools or pictures of tools.

THE NEXT LESSON IS: Heavy Masonry Equipment

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT:	Introduction to Bricklaying/Stone Masonry
TOPIC:	Heavy Masonry Equipment
ESSENTIAL ELEMENT(S):	T&I (7) A, D, E
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify heavy masonry equipment.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Make TMs to show heavy masonry equipment.
REFERENCES:	Bricklayer and Stonemason Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/Assignment Sheet/Heavy Masonry Equipment

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Show TMs of heavy masonry equipment. Check to see if students know the name of the equipment and what it is used for. By the end of the lesson, you will be able to identify heavy masonry equipment.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Heavy Masonry Equipment as a guide, discuss the various types of heavy equipment used in bricklaying/stone masonry.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Heavy Masonry Equipment to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Close by having students name equipment and tell what it is used for as you show TMs.

THE NEXT LESSON IS: Materials Used in Bricklaying/Stone Masonry

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Materials Used in Bricklaying/Stone Masonry

ESSENTIAL ELEMENT(S): T&I (7) A, D, E

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify materials used in bricklaying/stone masonry.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: Display of materials used in bricklaying/stone masonry

TEACHING AIDS: Make TMs to show bricklaying/stone masonry materials if materials are not available.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/ Assignment Sheet/Materials Used in Bricklaying/Stone Masonry

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Show bricklaying/stone masonry materials or TMs of materials. Check to see if students know the names of the materials and what they are used for. By the end of the lesson, you will be able to identify materials used in bricklaying/stone masonry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Materials Used in Bricklaying/Stone Masonry as a guide, discuss the types of materials used in bricklaying/stone masonry and how they are used.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Materials Used in Bricklaying/Stone Masonry to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Close by having students name materials and tell what they are used for as you show TMs.

THE NEXT LESSON IS: Mathematic Skills Used in Bricklaying/Stone Masonry

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT:	Introduction to Bricklaying/Stone Masonry
TOPIC:	Mathematic Skills Used in Bricklaying/Stone Masonry
ESSENTIAL ELEMENT(S):	T&I (7) A, B
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will have a knowledge of the mathematic skills necessary in bricklaying/stone masonry.

TOOLS AND EQUIPMENT:	Steel measuring tape, 12-inch rule, measuring cup, three glass containers (one quart each)
MATERIALS:	Water, blue and yellow food coloring, bleach
TEACHING AIDS:	Make TMs of figure one and table one
REFERENCES:	Bricklayer and Stonemason Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/ Assignment Sheet/Mathematic Skills Used in Bricklaying/Stone Masonry

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Mix yellow food coloring with one quart of water in one container. In the other, mix one quart of water with blue food coloring. At the beginning of the lesson, measure one cup of blue water and pour it into a glass quart jar. Add one cup of yellow water. Next pour in one-half cup of bleach. By the end of the lesson, you will be able to demonstrate a knowledge of the mathematic skills necessary for bricklaying/stone masonry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Explain that you have just added two parts yellow colored water, two parts blue colored water and one part bleach. Using SIS/Mathematic Skills Used in Bricklaying/Stone Masonry as a guide, discuss the types of mathematic skills used in bricklaying/stone masonry. Discuss that it is often necessary to make mixtures by adding measures by parts as you did at the first of the class.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Mathematic Skills Used in Bricklaying/Stone Masonry to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Close by having students give examples of how mathematic skills are used in bricklaying/stone masonry.

THE NEXT LESSON IS: Reading Drawings and Blueprints

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Reading Drawings and Blueprints

ESSENTIAL ELEMENT(S): T&I (7) A, C; Core (2) A

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be familiar with various types of drawings and blueprints utilized by bricklayers/stone masons.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TM of figure one.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/ Assignment Sheet/Reading Drawings and Blueprints

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Before you can successfully do any masonry work, you must know what the architect, contractor, or homeowner wants. To do this, you must be able to read blueprints. By the end of the lesson, you will be familiar with various types of drawings and blueprints utilized by bricklayers/stone masons.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Reading Drawings and Blueprints as a guide, discuss the types of drawings and blueprints used in bricklaying/stone masonry.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Reading Drawings and Blueprints to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Close by having students identify symbols shown on the TM of figure one.

THE NEXT LESSON IS: Using Masonry Ties

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Using Masonry Ties

ESSENTIAL ELEMENT(S): T&I (7) A, C; Core (2) B

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to understand the use of masonry ties.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: Display of masonry ties

TEACHING AIDS: Make TM of masonry ties.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/ Assignment Sheet/Using Masonry Ties

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that there are several techniques which are unique to bricklaying/stone masonry. Using masonry ties is one of these techniques. By the end of the lesson, you will be able to understand the use of masonry ties.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Using Masonry Ties as a guide, discuss how masonry ties are used. Show display of masonry ties and TMs of masonry ties.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Using Masonry Ties to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the types of masonry ties and how they are used.

THE NEXT LESSON IS: Using Reinforcing Bars

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Fundamentals of Bricklaying/Stone Masonry
TOPIC: Using Reinforcing Bars
ESSENTIAL ELEMENT(S): T&I (7) A, C; Core (2) B
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to understand the use of reinforcing bars.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: Display of reinforcing bars

TEACHING AIDS: Make TM of reinforcing bars.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/ Assignment Sheet/Using Reinforcing Bars

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Discuss that there are several techniques which are unique to bricklaying/stone masonry. Using reinforcing bars is one of these techniques. By the end of the lesson, you will be able to understand the use of reinforcing bars.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Using Reinforcing Bars as a guide, discuss how reinforcing bars are used. Show display of reinforcing bars and TM of reinforcing bars.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Using Reinforcing Bars to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the types of reinforcing bars and how they are used.

THE NEXT LESSON IS: Basic Construction Processes

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Fundamentals of Bricklaying/Stone Masonry
TOPIC: Basic Construction Processes
ESSENTIAL ELEMENT(S): T&I (7) A, C; Core (2) D
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be familiar with basic construction processes used in bricklaying/stone masonry.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of figures one through nine.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Student Information Sheet/ Assignment Sheet/Basic Construction Processes

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that each area of construction trades has its own basic construction processes. By the end of the lesson, you will be familiar with basic construction processes used in bricklaying/stone masonry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Basic Construction Processes as a guide, discuss the basic construction processes used in bricklaying/stone masonry. Show TMs to help promote class discussion.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Basic Construction Processes to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the construction process.

THE NEXT LESSON IS: Preparing, Mixing, and Spreading Mortar

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT:	Working in Bricklaying/Stone Masonry
TOPIC:	Preparing, Mixing, and Spreading Mortar
ESSENTIAL ELEMENT(S):	Common (2) E - I; T&I (2) E - I; (7) A, C; Core (2) E
TYPE OF LESSON:	Psychomotor, Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will prepare, mix, and spread mortar.

TOOLS AND EQUIPMENT:	Measuring cup, practice board (1"x6"x24"), mortar box, trowel, mortar stand, mortar hoe
MATERIALS:	Portland cement, hydrated lime, sand, water
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Bricklayer and Stonemason Introduction to Construction Careers/Bricklaying /Stone Masonry/Job Sheet/Preparing, Mixing, and Spreading Mortar

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In past lessons you have learned about safety, tools and equipment, and construction processes used in bricklaying/stone masonry. Today you will have the opportunity to use this information. By the end of the lesson, you will have prepared, mixed, and spread mortar.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Preparing, Mixing, and Spreading Mortar as a guide, discuss the general instructions given. Instruct the students to follow the procedures. Move about the room to assist as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Preparing, Mixing, and Spreading Mortar to meet this objective.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of preparing, mixing, and spreading mortar.

THE NEXT LESSON IS: Cleaning Tools and Walls

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Working in Bricklaying/Stone Masonry

TOPIC: Cleaning Tools and Walls

ESSENTIAL ELEMENT(S): Common (2) E - I; T&I (2) E - I; (7) A, C; Core (2) C

TYPE OF LESSON: Psychomotor, Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will demonstrate cleaning procedures for masonry tools and walls.

TOOLS AND EQUIPMENT: Gloves, wooden paddle or scraper, wire brush, garden hose, nozzle, chisel, bucket, measuring cup, stiff fiber brush

MATERIALS: Clean water, brisodium phosphate, household detergent

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Job Sheet/Cleaning Tools and Walls

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In past lessons you have learned about safety, tools and equipment, and construction processes used in bricklaying/stone masonry. Today you will have the opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to clean masonry tools and walls.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Cleaning Tools and Walls as a guide, discuss the general instructions given. Instruct the students to follow the procedures. Move about the room to assist as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Cleaning Tools and Walls to meet this objective.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of cleaning tools and walls.

THE NEXT LESSON IS: Constructing a Simple Brick Wall

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Working in Bricklaying/Stone Masonry
TOPIC: Constructing a Simple Brick Wall
ESSENTIAL ELEMENT(S): Common (2) E - I; T&I (2) E - I; (7) A, C; Core (2) F
TYPE OF LESSON: Psychomotor, Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will construct a simple brick wall.

TOOLS AND EQUIPMENT: Practice board (1"x6"x36"), trowel, mortar stand, shovel, joint raker

MATERIALS: Brick (7), mortar, water

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Job Sheet/Constructing a Simple Brick Wall

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
In past lessons you have learned about safety, tools and equipment, and construction processes used in bricklaying/stone masonry. Today you will have the opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to construct a simple brick wall.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Constructing a Simple Brick Wall as a guide, discuss the general instructions given. Instruct the students to follow the procedures. Move about the room to assist as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Constructing a Simple Brick Wall to meet this objective.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of constructing simple brick walls.

THE NEXT LESSON IS: Constructing a Simple Block Wall

LESSON PLAN

BRICKLAYING/STONE MASONRY

UNIT: Working in Bricklaying/Stone Masonry
TOPIC: Constructing a Simple Block Wall
ESSENTIAL ELEMENT(S): Common (2) E - I; T&I (2) E - I; (7) A, C; Core (2) F
TYPE OF LESSON: Psychomotor, Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will construct a simple block wall.

TOOLS AND EQUIPMENT: Practice board (1"x12"x36"), chalk line, mortar stand, shovel, mason's level, trowel, S-shaped joint raker

MATERIALS: 4 concrete blocks (1 corner block and 3 stretcher blocks), mortar, water

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Bricklayer and Stonemason
Introduction to Construction Careers/Bricklaying /Stone Masonry/Job Sheet/Constructing a Simple Block Wall

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
In past lessons you have learned about safety, tools and equipment, and construction processes used in bricklaying/stone masonry. Today you will have the opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to construct a simple block wall.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Constructing a Simple Block Wall as a guide, discuss the general instructions given. Instruct the students to follow the procedures. Move about the room to assist as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Constructing a Simple Block Wall to meet this objective.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of constructing simple block walls.

THE NEXT LESSON IS: The next lesson will begin a new section of construction careers.

SECTION IV

CARPENTRY

LESSON PLAN

CARPENTRY

UNIT:	Safety
TOPIC:	Ladder Safety
ESSENTIAL ELEMENT(S):	Common (4); T&I (4)
TYPE OF LESSON:	Cognitive, Psychomotor
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to: 1. cite general rules to observe when using ladders; 2. describe safety measures to take when using leaning ladders; and 3. give safety measures to take when using stepladders.
TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Carpenter Volume I Introduction to Construction Careers/Carpentry /Student Information Sheet/Assignment Sheet/Ladder Safety/Job Sheet/Setting Up a Stepladder

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus students' attention on safety. Provide examples of injuries which have occurred due to failure to follow safety rules. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why safety with ladders is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Ladder Safety as a guide, discuss ladder safety. Ask individual and group questions in order to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Ladder Safety to reinforce this area of instruction. Use JS/Setting Up a Stepladder as application of information.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Careers in Carpentry

LESSON PLAN

CARPENTRY

UNIT: Introduction to Careers in Carpentry
TOPIC: Careers in Carpentry
ESSENTIAL ELEMENT(S): Common (2) A, C, I, J; T&I (2) A, C, I, J
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements for carpentry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. describe various types of jobs performed by carpenters;
2. name locations where carpenters normally find employment; and
3. name the advantages and disadvantages of carpentry as a trade.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Invite an individual who is employed in the area of carpentry to speak to the class.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Careers in Carpentry

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Discuss that each area of construction trades has different characteristics. It is important to learn everything you can about a career before you make a choice. By the end of the lesson, you will have a knowledge of careers in carpentry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Careers in Carpentry as a guide, discuss the different careers available in the area of carpentry. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Careers in Carpentry to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: House Planning

LESSON PLAN

CARPENTRY

UNIT: Introduction to Careers in Carpentry

TOPIC: House Planning

ESSENTIAL ELEMENT(S): Common (2) A, C, I, J; T&I (2) A, C, I, J

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements for carpentry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to describe duties performed by the carpenter other than actual carpentry.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Invite an individual who is employed in the area of carpentry to speak to the class.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/House Planning

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Discuss that the duties of the carpenter involve many areas of activity. It is important to learn everything you can about a career before you make a choice; this includes learning about duties. By the end of the lesson, you will have a knowledge of the carpenter's responsibilities in regard to house planning.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/House Planning as a guide, discuss the different responsibilities of the carpenter in addition to actual carpentry work. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use AS/House Planning to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Building Contractors and Types of Construction

LESSON PLAN

CARPENTRY

UNIT: Being Your Own Boss

TOPIC: Building Contractors and Types of Construction

ESSENTIAL ELEMENT(S): Common (2) A; (3) A, B, D; T&I (2) A; (3) A, B, D

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will:

1. explain the forms or types of businesses that may be organized; and
2. discuss in what types of construction the building contractor may be involved.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Building Contractors and Types of Construction

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that not all carpenters work for someone else. Many carpenters choose to go into business for themselves. It is possible to start your own contracting business. By the end of the lesson, you will have a knowledge of how building contractors operate and the types of construction performed.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Building Contractors and Types of Construction as a guide, discuss the different types of contracting businesses possible and the different types of construction contractors are involved with.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Building Contractors and Types of Construction to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Setting Up a Construction Business

LESSON PLAN

CARPENTRY

UNIT:	Being Your Own Boss
TOPIC:	Setting Up a Construction Business
ESSENTIAL ELEMENT(S):	Common (2) A; (3) A, B, D; T&I (2) A; (3) A, B, D
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will identify entry-level procedures, planning processes, and terms needed to open a business.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Invite an individual who owns his/her own construction business to talk to your class.
REFERENCES:	Carpenter Volume I Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Setting Up a Construction Business

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Many carpenters choose to go into business for themselves. It is possible to start your own construction business. Introduce the speaker; remind students to pay close attention to how the individual started the business. By the end of the lesson, you will have a knowledge of how construction businesses are started.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Setting Up a Construction Business as a guide, discuss how construction businesses are started. Encourage the students to ask the speaker questions.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Setting Up a Construction Business in order to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Tools and Equipment

LESSON PLAN

CARPENTRY

UNIT: Introduction to Carpentry
TOPIC: Tools and Equipment
ESSENTIAL ELEMENT(S): T&I (7) A, D, E
TYPE OF LESSON: Cognitive, Psychomotor
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify tools used in carpentry.

TOOLS AND EQUIPMENT: Prepare a display of various tools discussed in the information sheet.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of carpentry tools.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Tools and Equipment/Job Sheets/Using Carpentry Hand Tools and Using Carpentry Power Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
The carpenter uses a wide variety of tools in the carpentry trade. In fact, you could very likely take a complete course which would deal specifically with carpentry tools. By the end of the lesson, you will be able to identify tools used in the carpentry trade.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Tools and Equipment as a guide, discuss the different types of tools and equipment used in carpentry. Show TMs to promote class discussion.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Tools and Equipment to reinforce this area of instruction. Use JS/Using Carpentry Hand Tool and Using Carpentry Power Tools as application of information.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson by showing TMs or tools and by having students give the name and use of each.

THE NEXT LESSON IS: Building Materials

LESSON PLAN

CARPENTRY

UNIT: Introduction to Carpentry

TOPIC: Building Materials

ESSENTIAL ELEMENT(S): T&I (7) A, D, E

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify materials used in the carpentry trade.

TOOLS AND EQUIPMENT: Prepare a display of various materials discussed in the information sheet.

MATERIALS: No special materials are required.

TEACHING AIDS: No special materials are required.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Building Materials

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
The carpenter uses a wide variety of materials in the carpentry trade. It is important that you be able to recognize these materials. By the end of the lesson, you will be able to identify materials used in the carpentry trade.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Building Materials as a guide, discuss the different types of materials used in the carpentry trade. Have students examine the display of materials. Be sure to answer any questions the students may have.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Building Materials to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson by showing materials and having students give the name and use of each.

THE NEXT LESSON IS: Carpentry Terminology

LESSON PLAN

CARPENTRY

UNIT:	Introduction to Carpentry
TOPIC:	Carpentry Terminology
ESSENTIAL ELEMENT(S):	T&I (7) A, C
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Carpenter Volume I Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Carpentry Terminology

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

When working in carpentry, you will encounter many terms which you may not be familiar with. It is very important that you recognize these terms and what they mean. By the end of the lesson, you will be able to understand carpentry terminology.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Carpentry Terminology as a guide, discuss the terminology used in the carpentry trade. Check for understanding by asking individual and group questions.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Carpentry Terminology to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson by reading terms and having students give the definitions.

THE NEXT LESSON IS: Introduction to Blueprints in Carpentry

LESSON PLAN

CARPENTRY

UNIT:	Fundamentals of Carpentry
TOPIC:	Introduction to Blueprints in Carpentry
ESSENTIAL ELEMENT(S):	T&I (7) A; (3)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of the use of blueprints in carpentry.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Examples of blueprints
REFERENCES:	Carpenter Volume I Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Introduction to Blueprints in Carpentry

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Would you start on a long trip without a road map? In carpentry, blueprints are road maps for the carpenter. Without blueprints, carpenters would be unable to build a structure that is precisely what the contractor, homeowner, or architect has in mind. By the end of the lesson, you will be able to demonstrate an understanding of the use of blueprints in carpentry.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Introduction to Blueprints in Carpentry as a guide, discuss the importance of knowing how to read blueprints. Check for understanding by asking individual and group questions. Show examples of blueprints.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Introduction to Blueprints in Carpentry to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Floor Framing

LESSON PLAN

CARPENTRY

UNIT: Fundamentals of Carpentry
TOPIC: Floor Framing
ESSENTIAL ELEMENT(S): T&I (7) A; (3)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of floor framing.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs to show part of a floor.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Floor Framing

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
When working in carpentry, you will find that there are many different parts to a structure. To simplify learning, we will deal with one part at a time. By the end of the lesson, you will be able to demonstrate an understanding of floor framing.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Floor Framing as a guide, discuss the techniques for constructing a floor. Check for understanding by asking individual and group questions. Show TMs to promote class discussion.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Floor Framing to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson by showing TMs and having students name the parts of a floor.

THE NEXT LESSON IS: Wall Framing

LESSON PLAN

CARPENTRY

UNIT: Fundamentals of Carpentry
TOPIC: Wall Framing
ESSENTIAL ELEMENT(S): T&I (7) A; (3)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.
SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of wall framing.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs to show part of a wall.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Wall Framing

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
When working in carpentry, you will find that there are many different parts to a structure. To simplify learning, we will deal with one part at a time. By the end of the lesson, you will be able to demonstrate an understanding of wall framing.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Wall Framing as a guide, discuss the techniques for building a wall. Check for understanding by asking individual and group questions. Show TMs to promote class discussion.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Wall Framing to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson by showing TMs and having students name the parts of a wall.

THE NEXT LESSON IS: Roof Construction

LESSON PLAN

CARPENTRY

UNIT:	Fundamentals of Carpentry
TOPIC:	Roof Construction
ESSENTIAL ELEMENT(S):	T&I (7) A; (3)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of roof construction.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Tms showing examples of roof construction
REFERENCES:	Carpenter Volume I Introduction to Construction Careers/Carpentry/ Student Information Sheet/Assignment Sheet/Roof Construction

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
You have studied different parts of structures; these include floor framing and wall framing. The final part of the outside structure to be built is the roof. By the end of the lesson, you will be able to demonstrate an understanding of roof construction.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Roof Construction as a guide, discuss the importance of knowing how roofs are constructed. Check for understanding by asking individual and group questions. Show examples of different types of roof construction.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Roof Construction to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Working with Hand and Power Tools

LESSON PLAN

CARPENTRY

UNIT:	Working in Carpentry
TOPIC:	Working with Hand and Power Tools
ESSENTIAL ELEMENT(S):	T&I (7) A; (3) A
TYPE OF LESSON:	Cognitive, Psychomotor
UNIT OBJECTIVE:	After completion of this unit, the student will be able to perform minor jobs in carpentry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will: 1. demonstrate the ability to square a board; 2. measure a board; and 3. cut a board using hand and power tools.

TOOLS AND EQUIPMENT:	Hand saw (cross cut), circular saw, framing square, tape measure, pencil
MATERIALS:	One board (2x4"x6')
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Carpenter Volume I Introduction to Construction Careers/Carpentry/ Job Sheet/Working with Hand and Power Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Within this section you have studied the basics of carpentry. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to measure, square, and cut a board using hand and power tools.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Working with Hand and Power Tools as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Working with Hand and Power Tools to fulfill the objectives.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Making a Form for a Concrete Slab

LESSON PLAN

CARPENTRY

UNIT:	Working in Carpentry
TOPIC:	Making a Form for a Concrete Slab
ESSENTIAL ELEMENT(S):	T&I (7) A; (3) B
TYPE OF LESSON:	Cognitive, Psychomotor
UNIT OBJECTIVE:	After completion of this unit, the student will be able to perform minor jobs in carpentry.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will have demonstrated the ability to build a form for a concrete slab.

TOOLS AND EQUIPMENT:	Hammer, framing square, 24-inch level, 16 d duplex nails, measuring tape, pencil
MATERIALS:	2 pieces 2"x4"x16" board, 2 pieces 2"x4"x19 1/4" board, 8 stakes
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Carpenter Volume I Introduction to Construction Careers/Carpentry/Job Sheet/Making a Form for a Concrete Slab

---

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Within this section you have studied the basics of carpentry. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to build a form for a concrete slab.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Making a Form for a Concrete Slab as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Making a Form for a Concrete Slab to fulfill the objectives.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Constructing a Cabinetry Component

LESSON PLAN

CARPENTRY

UNIT: Working in Carpentry
TOPIC: Constructing a Cabinetry Component
ESSENTIAL ELEMENT(S): T&I (7) A; (3) C
TYPE OF LESSON: Cognitive, Psychomotor
UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in carpentry.
SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will have demonstrated the ability to construct a cabinetry component.

TOOLS AND EQUIPMENT: No. 2 1/2 or 3 common pencil, 12" ruler, coping saw, , 2 C-clamps, drill, paintbrush

MATERIALS: 1 piece of 1/4" plywood 12" x 12", sandpaper, four to six cuphooks, newspaper, paint or varnish, cleaning solvent

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Carpenter Volume I
Introduction to Construction Careers/Carpentry/Job Sheet/Constructing a Cabinetry Component

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Within this section you have studied the basics of carpentry. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to construct a cabinetry component.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Constructing a Cabinetry Component as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Constructing a Cabinetry Component to fulfill the objectives.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: In the next lesson we will begin a new section of construction careers.

SECTION V

RESIDENTIAL ELECTRICIAN TRADE

RESIDENTIAL
ELECTRICIAN TRADE

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Safety

TOPIC: Electrical Safety Terms and Definitions

ESSENTIAL ELEMENT(S): Common (4); T&I (4)

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to match the terms and definitions associated with electrical safety.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/Electrical Safety Terms and Definitions

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus students' attention on safety. Provide examples of injuries which have occurred due to failure to follow safety rules. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why electrical safety is especially important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Electrical Safety Terms and Definitions as a guide, discuss electrical safety. Ask individual and group questions in order to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Electrical Safety Terms and Definitions to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Electrical Accidents

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Safety
TOPIC: Electrical Accidents
ESSENTIAL ELEMENT(S): Common (4); T&I (4)
TYPE OF LESSON: Cognitive, Psychomotor
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to discuss the causes and effects of electrical accidents.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/Electrical Accidents/Job Sheet/Safety Check

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Focus students' attention on safety. Provide examples of injuries which have occurred due to failure to follow safety rules. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why electrical safety is especially important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Electrical Accidents as a guide, discuss electrical safety. Ask individual and group questions in order to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Electrical Accidents to reinforce this area of instruction. Use JS/Safety Check as application of information.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Occupational Outlook

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Introduction to Careers in the Residential Electrician Trade
TOPIC: Occupational Outlook
ESSENTIAL ELEMENT(S): Common (2) A, C, I, J; T&I (2) A, C, I, J
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this of this unit, the student will be able to understand employment/career opportunities and training requirements in the electrical trades.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to discuss career opportunities available in the area of electrical trades.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Invite an individual who is employed in the area of electrical trades to speak to your class.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/Occupational Outlook

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that each area of construction has different characteristics. It is important that you learn everything you can about a career before you make a choice. (Introduce the speaker, and remind students to listen carefully.) By the end of the lesson, you will be able to discuss career opportunities available in the area of electrical trades.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Occupational Outlook as a guide, discuss the various occupations available in the area of electrical trades. Encourage the students to ask the speaker questions.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Occupational Outlook to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Sources of Electrical Power

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Introduction to the Residential Electrician Trade

TOPIC: Sources of Electrical Power

ESSENTIAL ELEMENT(S): T&I (7) A; Core (4) A

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to discuss sources of electrical power.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: You may wish to secure pictures of different types of power plants, power lines, etc.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/Sources of Electrical Power

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Ask students to name sources of electrical power. Ask if anyone knows where the electricity which powers your classroom comes from. (Check prior to class to see what type of power plant is in your area.) By the end of the lesson, you will be able to discuss sources of electrical power.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Sources of Electrical Power as a guide, discuss the various sources of electrical power. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Sources of Electrical Power to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Uses of Electrical Power

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT:	Introduction to the Residential Electrician Trade
TOPIC:	Uses of Electrical Power
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (4) B
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to discuss the uses of electrical power.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	You may wish to bring pictures of various electrical powered appliances or machines.
REFERENCES:	General Construction Trades: Electrical Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/Uses of Electrical Power

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Ask students to write down how they have personally used electricity today. By the end of the lesson, you will be able to discuss the uses of electrical power.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Uses of Electrical Power as a guide, discuss the various ways in which electrical power is used. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Uses of Electrical Power to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: What Tools Are Used by Electricians?

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Introduction to the Residential Electrician Trade

TOPIC: What Tools Are Used by Electricians?

ESSENTIAL ELEMENT(S): T&I (7) A, D, E

TYPE OF LESSON: Cognitive, Psychomotor

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be familiar with the tools used by electricians.

TOOLS AND EQUIPMENT: Prepare a display of electrical tools.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of electrical tools.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/What Tools Are Used by Electricians?/Job Sheet Using Electrical Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

As you now realize, there are many different types of tools used in construction careers. Some of the tools used in electrical work will be familiar; however, many tools are used specifically in electrical work. By the end of the lesson, you will be familiar with the tools used by electricians.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/What Tools Are Used by Electricians? as a guide, discuss the various tools used in the electrical trade. Have students identify tools in display or shown in TMs.

STUDENT ACTIVITIES (APPLICATION)

Use AS/What Tools Are Used by Electricians? to reinforce this area of instruction. Use JS/Using Electrical Tools as application of information.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: What Materials Are Used by Electricians?

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Introduction to the Residential Electrician Trade

TOPIC: What Materials Are Used by Electricians?

ESSENTIAL ELEMENT(S): T&I (7) A, D, E

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be familiar with the materials used by electricians.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: Prepare a display of electrical materials.

TEACHING AIDS: Make TMs of electrical materials.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/What Materials Are Used by Electricians?

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

As you now realize, there are many different types of tools used in construction careers. There are also many different types of materials used. It is important that you become familiar with each type of material used in electrical work. By the end of the lesson, you will be familiar with the materials used by electricians.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/What Materials Are Used by Electricians? as a guide, discuss the various materials used in the electrical trade. Have students identify materials in display or shown in TMs.

STUDENT ACTIVITIES (APPLICATION)

Use AS/What Materials Are Used by Electricians? to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Basic Electrical Circuits

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Fundamentals of the Residential Electrician Trade

TOPIC: Basic Electrical Circuits

ESSENTIAL ELEMENT(S): T&I (7) A; Core (4) C

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of the residential electrician trade.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of basic electric theory.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of figures one and two.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/Basic Electrical Circuits

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

You have now learned a little about where electricity comes from, the type of tools and materials which are used, and the safety precautions. It is important that you become familiar with basic electrical circuits in order to know how electricity is used in the electrician trade. By the end of the lesson, you will be familiar with basic electrical circuits.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Basic Electrical Circuits as a guide, discuss the how circuits are used to carry electricity. Show TMs to reinforce this area of information.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Basic Electrical Circuits to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: The Electron Theory and Ohm's Law

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT:	Fundamentals of the Residential Electrician Trade
TOPIC:	The Electron Theory and Ohm's Law
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (4) C
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of the residential electrician trade.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to discuss the electron theory and Ohm's Law.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Make TMs of figures one through five.
REFERENCES:	General Construction Trades: Electrical Introduction to Construction Careers/Residential Electrician Trade/Student Information Sheet/Assignment Sheet/The Electron Theory and Ohm's Law

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In addition to knowing about electrical circuits, electricians must be familiar with the electron theory and Ohm's Law. It is often the responsibility of the electrician to figure the amount of current and voltage needed. By the end of the lesson, you will be familiar the electron theory and Ohm's law.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/The Electron Theory and Ohm's Law as a guide, discuss the relationship of circuits and voltage. Show TMs to reinforce this area of information.

STUDENT ACTIVITIES (APPLICATION)

Use AS/The Electron Theory and Ohm's Law to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Wiring a Light and Single Pole Switch Circuit

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Working in the Residential Electrician Trade

TOPIC: Wiring a Light and Single Pole Switch Circuit

ESSENTIAL ELEMENT(S): T&I (7) A; Core (4) D

TYPE OF LESSON: Psychomotor, Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in the residential electrician trade.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will demonstrate the ability to wire a light and single pole switch circuit.

TOOLS AND EQUIPMENT: Practice board with empty device box and empty octagon box, single pole switch, light socket, 120v supply line, 120v incandescent bulb, ling nose plier, pocket knife, wire strippers, safety glasses

MATERIALS: 12-2-G or 14-2-G NM cable, wire connectors

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Job Sheet/Wiring a Light and Single Pole Switch Circuit

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Within this section you have studied the basics of electricity. Today you will have an opportunity to use what you have learned. By the end of the lesson, you will have wired a light and single pole switch circuit.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Wiring a Light and Single Pole Switch Circuit as a guide, discuss the general instructions given. Instruct students to follow procedures. Move about the room to provide assistance as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Wiring a Light and Single Pole Switch Circuit to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Practicing Simple Electrical Troubleshooting

LESSON PLAN

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Working in the Residential Electrician Trade

TOPIC: Practicing Simple Elecrical Troubleshooting

ESSENTIAL ELEMENT(S): T&I (7) A; Core (4) E

TYPE OF LESSON: Psychomotor, Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in the residential electrician trade.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will demonstrate the ability to do Simple electrical troubleshooting

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TOOLS AND EQUIPMENT: Neon Tester, practice box designed by instructor for this exercise

MATERIALS: No special materials are required

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Electrical
Introduction to Construction Careers/Residential Electrician Trade/Job Sheet/Practicing Simple Electrical Troubleshooting

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Within this section you have studied the basics of electricity. Today you will have an opportunity to use what you have learned. By the end of the lesson, you will demonstrate the ability to do simple electrical troubleshooting.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Practivticing Simple Electrical Troubleshooting as a guide, discuss the general instructions given. Instruct students to follow procedures. Move about the room to provide assistance as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Practicing Simple Electrical Troubleshooting to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: In the next lesson we will begin a new section of construction careers.

SECTION VI

PAINTING AND DECORATING

PAINTING AND DECORATING

LESSON PLAN

PAINTING AND DECORATING

UNIT:	Safety
TOPIC:	Painting Safety
ESSENTIAL ELEMENT(S):	Common (4); T&I (4)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify safe working practices.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Painting Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Assignment Sheet/Painting Safety

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus student's attention on the importance of safety. Provide examples of injuries which occurred due to failure to follow safety precautions. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why safety is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Painting Safety as a guide, present safety information. Discuss the information provided; ask questions requiring individual and group responses.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Painting Safety as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of ICC/AS/Painting Safety.

SUMMARY/CLOSURE

In this lesson you have learned the importance of safety practices while painting. Not only is it important that you observe safe working practices but also it is important that others practice safety.

THE NEXT LESSON IS: Occupational Information

LESSON PLAN

PAINTING AND DECORATING

UNIT: Introduction to Careers in Painting and Decorating
TOPIC: Occupational Information
ESSENTIAL ELEMENT(S): Common (2) A, C, I, J; T&I (2) A, C, I, J
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements for painters and decorators.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. identify employment/career opportunities for painters and decorators; and
2. identify training requirements for painters and decorators.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Painting
Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Assignment Sheet/Occupational Information

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Discuss the importance of finding out all you can about a career before you begin working in the career. By the end of the lesson, you will be able to demonstrate a knowledge of occupations in painting and decorating.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Occupational Information as a guide, discuss the various occupations available in the area of painting and decorating. Discuss the information provided. Ask questions requiring individual and group responses.

STUDENT ACTIVITIES (APPLICATION)
Use ICC/AS/Occupational Information as independent practice.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through scoring of AS/Occupational Information.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Tools and Equipment

LESSON PLAN

PAINTING AND DECORATING

UNIT: Introduction to Painting and Decorating

TOPIC: Tools and Equipment

ESSENTIAL ELEMENT(S): T&I (7) A, D, E

TYPE OF LESSON: Cognitive, Psychomotor

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with painting and decorating.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify tools and equipment necessary for painting, drywall finishing, and paper hanging.

TOOLS AND EQUIPMENT: Prepare a display of painting tools and equipment.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of painting tools and equipment.

REFERENCES: General Construction Trades: Painting
Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Assignment Sheet/Tools and Equipment/Job Sheet/Using Painting and Decorating Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Hold up several of the tools or show TMs of tools and equipment. Have students try to identify each and tell what it is used for . By the end of the lesson, you will be able to identify tools and equipment used in painting and decorating.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Tools and Equipment as a guide, discuss the various tools and equipment used in painting and decorating. Discuss the information provided; ask questions requiring individual and group responses.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Tools and Equipment as independent practice. Use JS/Using Painting and Decorating Tools as application of information.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of AS/Tools and Equipment.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Learning About Materials

LESSON PLAN

PAINTING AND DECORATING

UNIT: Introduction to Painting and Decorating
TOPIC: Learning About Materials
ESSENTIAL ELEMENT(S): T&I (7) A, D, E
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE. After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with painting and decorating.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify materials for painting, drywall finishing, and paper hanging.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: Prepare a display of painting and decorating materials.

TEACHING AIDS: Make TMs of painting and decorating materials.

REFERENCES: General Construction Trades: Painting
Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Assignment Sheet/Learning About Materials

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Hold up several of the materials or TMs of materials used in painting and decorating. Have students try to identify each and tell what it is used for . By the end of the lesson, you will be able to identify materials used in painting and decorating.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Learning About Materials as a guide, discuss the various materials used in painting and decorating. Discuss the information provided; ask questions requiring individual and group responses.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Learning About Materials as independent practice.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through scoring assignment sheet.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Basics of Color

LESSON PLAN

PAINTING AND DECORATING

UNIT:	Fundamentals of Painting and Decorating
TOPIC:	Basics of Color
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (5) A
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be familiar with the basics of color, including psychology, selection, and styling.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Color chart (You may wish to use color selection samples from a paint store.)
REFERENCES:	General Construction Trades: Painting Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Assignment Sheet/Basics of Color

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Ask students to write down their favorite color, the color they feel the classroom should be painted, and the color of car they would like. Compare some of the responses. By the end of the lesson, you will be familiar with the basics of color, including psychology, selection, and styling.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Basics of Color as a guide, discuss the selection of color and how different colors have different psychological effects. Encourage students to ask questions. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Basics of Color to reinforce this area of information.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through scoring assignment sheet.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Understanding Painting and Cleanup Procedures

LESSON PLAN

PAINTING AND DECORATING

UNIT: Fundamentals of Painting and Decorating
TOPIC: Understanding Painting and Cleanup Procedures
ESSENTIAL ELEMENT(S): T&I (7) A; Core (5) B
TYPE OF LESSON: Cognitive, Psychomotor
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of painting and cleanup procedures.

TOOLS AND EQUIPMENT: Slide projector or film strip projector

MATERIALS: No special materials are required.

TEACHING AIDS: You may wish to show slides or filmstrip of painting and cleanup.

REFERENCES: General Construction Trades: Painting
Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Assignment Sheet/Understanding Painting and Cleanup Procedures/Job Sheet/Using Masking Tape

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Painting a surface and cleaning tools and equipment appear to be very simple. There are steps which should be followed, however, in order to do the job correctly. By the end of the lesson, you will be familiar with painting and cleanup procedures.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Understanding Painting and Cleanup Procedures as a guide, discuss the processes used in painting and cleanup. Encourage students to ask questions. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Understanding Painting and Cleanup Procedures to reinforce this area of information. Use JS/Using Masking Tape as application of information.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring assignment sheet.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Drywall Finishing

LESSON PLAN

PAINTING AND DECORATING

UNIT:	Fundamentals of Painting and Decorating
TOPIC:	Drywall Finishing
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (5) E
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be familiar with the fundamental processes of drywall finishing.

TOOLS AND EQUIPMENT:	Prepare a display of drywall tools.
MATERIALS:	Prepare a display of drywall materials.
TEACHING AIDS:	You may wish to show slides or filmstrip of drywall finishing.
REFERENCES:	General Construction Trades: Painting Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Assignment Sheet/Drywall Finishing

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
As you have seen before, painting and decorating involve more than just painting. Drywall finishing is an important step which must be completed before painting and decorating may be done. By the end of the lesson, you will be familiar with the fundamental processes of drywall finishing.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Drywall Finishing as a guide, discuss the processes used in drywall finishing. Encourage students to ask questions. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Drywall Finishing to reinforce this area of information.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through scoring assignment sheet.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Preparing a Surface for Painting

LESSON PLAN

PAINTING AND DECORATING

UNIT: Working in Painting and Decorating
TOPIC: Preparing a Surface for Painting
ESSENTIAL ELEMENT(S): T&I (7) A; Core (5) C
TYPE OF LESSON: Psychomotor, Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in painting and decorating.
SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will demonstrate the ability to prepare a surface for painting.

TOOLS AND EQUIPMENT: Hammer, (13 oz.), joint knife, joint trowel

MATERIALS: Joint compound, perforated paper tape, sandpaper, new drywall covered wall

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Painting
Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Job Sheet/Preparing a Surface for Painting

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
In past lessons you have learned about the basic processes used in painting and decorating. Today you will have the opportunity to put that knowledge into operation. By the end of the lesson, you will have demonstrated the ability to prepare a surface for painting.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Preparing a Surface for Painting as a guide, discuss the general instructions given. Instruct students to follow the procedures. Move about the room to assist as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Preparing a Surface for Painting to meet the objectives.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Painting Surfaces

PAINTING AND DECORATING

LESSON PLAN

PAINTING AND DECORATING

UNIT:	Working in Painting and Decorating
TOPIC:	Painting a Surface
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (5) D
TYPE OF LESSON:	Psychomotor, Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to perform minor jobs in painting and decorating.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will demonstrate the ability to paint, lacquer, or varnish wood, metal, or synthetic surfaces.

TOOLS AND EQUIPMENT:	Flat paddle or shaker, clean container for mixing, paintbrush, roller or sprayer
MATERIALS:	Paint cloths and covers, paint (oil-based or latex), thinner or solvent (if necessary), surface to paint
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Painting Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Job Sheet/Painting a Surface

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In past lessons you have learned about the basic processes used in painting and decorating. Today you will have the opportunity to put that knowledge into operation. By the end of the lesson, you will have demonstrated the ability to paint a surface.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Painting a Surface as a guide, discuss the general instructions given. Instruct students to follow the procedures. Move about the room to assist as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Painting a Surface to meet the objectives.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Hanging Paper

LESSON PLAN

PAINTING AND DECORATING

UNIT:	Working in Painting and Decorating
TOPIC:	Hanging Paper
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (5) F
TYPE OF LESSON:	Psychomotor, Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to perform minor jobs in painting and decorating.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will demonstrate the basics techniques of: 1. selection of materials; 2. estimation of materials; 3. preparation of surfaces; and 4. paper hanging.

TOOLS AND EQUIPMENT:	Smoothing brush, wallpaper shears, paper knife, trowel, wallpaper samples, practice wall
MATERIALS:	1 roll pre-pasted wallpaper, joint compound, sandpaper
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Painting Introduction to Construction Careers/Painting and Decorating/Student Information Sheet and Job Sheet/Hanging Paper

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

In past lessons you have learned about the basic processes used in painting and decorating. Today you will have the opportunity to put that knowledge into operation. By the end of the lesson, you will have demonstrated the basic techniques of hanging paper.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Hanging Paper as a guide, discuss the general instructions given. Instruct students to follow the procedures. Move about the room to assist as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Hanging Paper to meet the objectives.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: In the next lesson we will begin a new section of construction careers.

SECTION VII

PLUMBING/PIPEFITTING

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Safety

TOPIC: Personal Safety

ESSENTIAL ELEMENT(S): Common (4); T&I (4)

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify safe working practices.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Plumber
Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Personal Safety

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus students' attention on safety. Provide examples of injuries which have occurred due to failure to follow safety rules. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why personal safety is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Personal Safety as a guide, discuss personal safety. Ask individual and group questions in order to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Personal Safety to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Safe Handling and Storage of Materials and Tools

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT:	Safety
TOPIC:	Safe Handling and Storage of Materials and Tools
ESSENTIAL ELEMENT(S):	Common (4); T&I (4); (7) E
TYPE OF LESSON:	Cognitive, Psychomotor
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to: 1. explain what good housekeeping means; 2. discuss rules for working safely; 3. tell what element causes most accidents; and 4. explain how to lift loads without injuring your back.
TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Plumber Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Safe Handling and Storage of Materials and Tools/Job Sheet/Using Personal Protective Equipment

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Focus students' attention on safety. Provide examples of injuries which have occurred due to failure to follow safety rules. By the end of the lesson, you will be able to recognize unsafe working practices and discuss why the safe handling and storage of materials and tools is important.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Safe Handling and Storage of Materials and Tools as a guide, discuss why it is important to use safety procedures when handling and storing materials and tools. Ask individual and group questions in order to determine learning.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Safe Handling and Storage of Materials and Tools to reinforce this area of instruction. Use JS/Using Personal Protective Equipment as application of information.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Occupational Information

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Introduction to Careers in Plumbing/Pipefitting

TOPIC: Occupational Information

ESSENTIAL ELEMENT(S): Common (2) A, C, I, J; T&I (2) A, C, I, J

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in the piping trades.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. identify the basic jobs, specific tasks, and type of information that must be learned by plumbers and pipefitters;
2. discuss training given plumbers and pipefitters; and
3. discuss the job outlook and possibilities for advancement for plumbers and pipefitters.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Classified ads from newspapers

REFERENCES: Plumber
Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Occupational Information

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Provide students with the classified section of the newspaper. (Have students share if there are too few copies.) Have each student find one job opening and list the requirements for that job. Be the end of the lesson, you will be able to discuss the types of work done in plumbing/pipefitting.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Occupational Information as a guide, discuss the occupational outlook for plumbing/pipefitting. Use personal experiences or information about others' experiences to reinforce this area of instruction.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Occupational Information to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

PLUMBING
PIPEFITTING

THE NEXT LESSON IS: Owning a Plumbing Business

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Being Your Own Boss
TOPIC: Owning a Plumbing Business
ESSENTIAL ELEMENT(S): Common (3) A, B; (5) A, B, E; (6) G; T&I (3) A, B; (5) A, B, E; (6) G
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. explain the types of work done by the two kinds of plumbing businesses;
2. explain the business responsibilities for licenses, taxes, bonds, etc.;
3. explain how contract payments are made; and
4. explain how small businesses save money.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: You may wish to invite an outside speaker who owns a plumbing/pipefitting business.

REFERENCES: Plumber
Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Owning a Plumbing Business

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Review the lesson on Occupational Outlook. Introduce the speaker. Instruct students to write down important facts regarding how plumbing businesses are started. By the end of the lesson, you will be able to discuss what is involved in owning a plumbing business.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Owning a Plumbing Business as a guide, discuss the types of things involved in owning a plumbing business. Allow the speaker enough time to speak. Encourage students to ask questions.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Owning a Plumbing Business to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Plumbing/Pipefitting Tools

PLUMBING
PIPEFITTING

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT:	Introduction to Plumbing/Pipefitting
TOPIC:	Plumbing/Pipefitting Tools
ESSENTIAL ELEMENT(S):	T&I (7) A, D, E
TYPE OF LESSON:	Cognitive, Psychomotor
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the plumbing trade.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify tools used in plumbing/pipefitting.

TOOLS AND EQUIPMENT:	Prepare a display of plumbing/pipefitting tools.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Make TMs of plumbing/pipefitting tools.
REFERENCES:	Plumber Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Plumbing/Pipefitting Tools/Job Sheet/Using Plumbing/Pipefitting Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

The plumber/pipefitter uses a wide variety of tools. By the end of the lesson, you will be able to identify tools used in plumbing/pipefitting.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Plumbing/Pipefitting Tools as a guide, discuss the various types of plumbing/pipefitting tools used. Have students examine the display of tools. Encourage students to ask questions.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Plumbing/Pipefitting Tools to reinforce this area of instruction. Use JS/Using Plumbing/Pipefitting Tools as application of information.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson. Have students name tools used in plumbing/pipefitting.

THE NEXT LESSON IS: Materials Used in Plumbing/Pipefitting

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Introduction to Plumbing/Pipefitting
TOPIC: Materials Used in Plumbing/Pipefitting
ESSENTIAL ELEMENT(S): T&I (7) A, D, E
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the plumbing trade.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify materials used in plumbing/pipefitting.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: Prepare a display of plumbing/pipefitting materials.

TEACHING AIDS: Make TMs of plumbing/pipefitting materials.

REFERENCES: Plumber
Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Materials Used in Plumbing/Pipefitting

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
The plumber/pipefitter uses a wide variety of materials. By the end of the lesson, you will be able to identify materials used in plumbing/pipefitting.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Materials Used in Plumbing/Pipefitting as a guide, discuss the various types of plumbing/pipefitting materials used. Have students examine the display of materials. Encourage students to ask questions.

STUDENT ACTIVITIES (APPLICATION)
Use AS/Materials Used in Plumbing /Pipefitting to reinforce this area of instruction.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson. Have students name materials used in plumbing/pipefitting.

THE NEXT LESSON IS: Plumbing Fixtures

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT:	Introduction to Plumbing/Pipefitting
TOPIC:	Plumbing Fixtures
ESSENTIAL ELEMENT(S):	T&I (7) A, D, E
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the plumbing trade.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify plumbing fixtures.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	Prepare a display of plumbing fixtures.
TEACHING AIDS:	Make TMs of plumbing fixtures.
REFERENCES:	Plumber Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Plumbing Fixtures

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Do you have any idea of how many different plumbing fixtures are used? Plumbers must be able to recommend and install various types of plumbing fixtures. By the end of the lesson, you will be able to identify fixtures used in plumbing.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Plumbing Fixtures as a guide, discuss the various types of plumbing fixtures used. Have students examine the display of fixtures or show TMs. Encourage students to ask questions.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Plumbing Fixtures to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson. Show TMs of plumbing fixtures; have students name each one.

THE NEXT LESSON IS: Plumbing Symbols

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT:	Introduction to Plumbing/Pipefitting
TOPIC:	Plumbing Symbols
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (6)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the plumbing trade.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be familiar with the symbols used in plumbing/pipefitting.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	Make TM of plumbing symbols.
REFERENCES:	Plumber Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Plumbing Symbols

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Have the class draw a blueprint of a bath. Ask that they indicate where the tub, water closet, and lavatory will be installed. Next have students compare drawings. How many different types of drawings or symbols have been used to represent the fixtures? By the end of the lesson, you will be familiar with symbols used in plumbing.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Plumbing Symbols as a guide, discuss the various types of symbols used in plumbing. Discuss the importance of using the same type of symbols. Show TMs to reinforce the information.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Plumbing Symbols to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson. Show TMs of plumbing symbols; have students name each one.

THE NEXT LESSON IS: Laying Out and Installing Water Supply Systems

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Fundamentals of Plumbing/Pipefitting

TOPIC: Laying Out and Installing Water Supply Systems

ESSENTIAL ELEMENT(S): T&I (7) A; Core (6)

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. explain why the plumber designs most residential water systems;
2. name and explain the factors that affect the amount of water available at each fixture;
3. explain why a uniform plumbing code is impossible; and
4. explain the terms roughing-in, topping-out, and setting fixtures.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TMs of figures one and two.

REFERENCES: Plumber
Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Laying Out and Installing Water Supply Systems

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

What type of information would you need to layout and install a water supply system? (List items on the board as students name them.) By the end of the lesson, you will be familiar with the type of information plumbers need in order to layout and install water supply systems.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Laying Out and Installing Water Supply Systems as a guide, discuss the information plumbers need in order to layout and install water supply systems. Show TMs to reinforce the information.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Laying Out and Installing Water Supply Systems to reinforce this area of instruction.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

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THE NEXT LESSON IS: Laying Out and Installing Drain, Waste, and Vent Systems

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Fundamentals of Plumbing/Pipefitting
TOPIC: Laying Out and Installing Drain, Waste, and Vent Systems
ESSENTIAL ELEMENT(S): T&I (7) A; Core (6)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to:

1. explain the function of the DWV system;
2. explain why the DWV system is laid before the water apply system;
3. explain why the DWV system must be laid at a grade between 1/4-inch and 1/8-inch fall;
4. explain why the size of the DWV pipe is important; and
5. explain why the DWV system must be vented.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TM of table one.

REFERENCES: Plumber
Introduction to Construction Careers/Plumbing/Pipefitting/Student Information Sheet/Assignment Sheet/Laying Out and Installing Drain, Waste, and Vent System

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

What type of information would you need to layout and install a drain, waste, and vent system? (List items on the board as students name them.) By the end of the lesson, you will be familiar with the type of information plumbers need in order to layout and install drain, waste, and vent systems.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Laying Out and Installing Drain, Waste, and Vent Systems as a guide, discuss the information plumbers need in order to layout and install drain, waste, and vent systems.

STUDENT ACTIVITIES (APPLICATION)

Use AS/Laying Out and Installing Drain, Waste, and Vent Systems to fulfill the objectives.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on assignment sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Bending Copper Tubing

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Working in Plumbing/Pipefitting

TOPIC: Bending Copper Tubing

ESSENTIAL ELEMENT(S): T&I (7) A; Core (6) A

TYPE OF LESSON: Psychomotor, Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will have demonstrated the ability to bend pipe according to instructions.

TOOLS AND EQUIPMENT: Tubing cutter, 3/8-inch level type tubing bender

MATERIALS: Twelve inches 3/8-inch O.D. (outside diameter) copper tubing

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Plumber

Introduction to Construction Careers/Carpentry/Job Sheet/Bending Copper Tubing

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Within this section you have studied the basics of plumbing/pipefitting. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to bend copper tubing.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Bending Copper Tubing as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Bending Copper Tubing to fulfill the objectives.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Sweating a Joint

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Working in Plumbing/Pipefitting
TOPIC: Sweating a Joint
ESSENTIAL ELEMENT(S): T&I (7) A; Core (6) B
TYPE OF LESSON: Psychomotor, Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will have demonstrated the ability to sweat a joint.

TOOLS AND EQUIPMENT: Tubing cutter with reamer, propane torch, safety glasses, soldering block

MATERIALS: 3/8-inch copper tubing, 3/8-inch copper sweat fitting, fine sandpaper, solder, solder flux

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Plumber
Introduction to Construction Careers/Carpentry/Job Sheet/Sweating a Joint

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Within this section you have studied the basics of plumbing/pipefitting. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to sweat a joint.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Sweating a Joint as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Sweating a Joint to fulfill the objectives.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Cutting Steel Pipe

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Working in Plumbing/Pipefitting

TOPIC: Cutting Steel Pipe

ESSENTIAL ELEMENT(S): T&I (7) A; Core (6) A

TYPE OF LESSON: Psychomotor, Cognitive

UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will have demonstrated the ability to cut steel pipe.

TOOLS AND EQUIPMENT: Pipe vise, hacksaw, folding ruler, pipe cutter, reamer

MATERIALS: Length of steel pipe (1/2 or 3/4-inch diameter)

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Plumber
Introduction to Construction Careers/Carpentry/Job Sheet/Cutting Steel Pipe

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Within this section you have studied the basics of plumbing/pipefitting. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to cut steel pipe.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using JS/Cutting Steel Pipe as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)

Use JS/Cutting Steel Pipe to fulfill the objectives.

EVALUATION/VERIFICATION

Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS: Threading Steel Pipe

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT:	Working in Plumbing/Pipefitting
TOPIC:	Threading Steel Pipe
ESSENTIAL ELEMENT(S):	T&I (7) A; Core (6) A
TYPE OF LESSON:	Psychomotor, Cognitive
UNIT OBJECTIVE:	After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will have demonstrated the ability to thread steel pipe.

TOOLS AND EQUIPMENT:	Pipe vise, file, correct size pipe threader, wire brush
MATERIALS:	Cutting oil, pipe prepared in job sheet "Cutting Steel Pipe"
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Plumber Introduction to Construction Careers/Carpentry/Job Sheet/Threading Steel Pipe

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Within this section you have studied the basics of plumbing/pipefitting. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to thread steel pipe.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Threading Steel Pipe as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Threading Steel Pipe to fulfill the objectives.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: Joining Pipe

LESSON PLAN

PLUMBING/PIPEFITTING

UNIT: Working in Plumbing/Pipefitting
TOPIC: Joining Pipe
ESSENTIAL ELEMENT(S): T&I (7) A; Core (6) C
TYPE OF LESSON: Psychomotor, Cognitive
UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will have demonstrated the ability to join pipe.

TOOLS AND EQUIPMENT: 2 pipe wrenches (rated for the size of pipe being used)

MATERIALS: Length of pipe from job sheet "Threading Steel Pipe," one 90° elbow of the same size, joint compound or Teflon tape, cloth

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Plumber
Introduction to Construction Careers/Carpentry/Job Sheet/Joining Pipe

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Within this section you have studied the basics of plumbing/pipefitting. Today you will have an opportunity to use this information. By the end of the lesson, you will have demonstrated the ability to join pipe.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using JS/Join Pipe as a guide, discuss the general instructions. Instruct the students to follow the procedures given. Move about the room to give assistance as needed.

STUDENT ACTIVITIES (APPLICATION)
Use JS/Joining Pipe to fulfill the objectives.

EVALUATION/VERIFICATION
Evaluation may be done by checking students' work on job sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS: In the next lesson we will begin a new section of construction careers.

SECTION VIII

COMMON ESSENTIAL ELEMENTS

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT:	Leadership
TOPIC:	Leadership Terms and Definitions
ESSENTIAL ELEMENT(S):	Common (1); T&I (1)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of leadership concepts and skills.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify terms and definitions associated with leadership.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Introduction Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Leadership Terms and Definitions

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that when learning about any area of education it is important to know the terms and definitions associated with that area. By the end of the lesson, you will be able to identify terms and definitions associated with leadership.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Leadership Terms and Definitions as a guide, discuss each of the terms and their meaning. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Leadership Terms and Definitions as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review several of the terms discussed in the lesson. Have students give the meanings.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT: Leadership
TOPIC: Parliamentary Procedures
ESSENTIAL ELEMENT(S): Common (1); T&I (1)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of leadership concepts and skills.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of parliamentary procedures.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: Make TM showing Essentials of a Good Meeting.

REFERENCES: General Construction Trades: Introduction
Introduction to Construction Careers/Common Essential Elements/Student Information Sheet/Parliamentary Procedures/Assignment Sheet/Planning and Conducting a Meeting

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
You may not think that you will ever be called on to conduct a meeting. However, it is a good idea to know how a meeting should be conducted. By the end of the lesson, you will be able to demonstrate an understanding of parliamentary procedures.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Parliamentary Procedures as a guide, discuss the steps taken when conducting a meeting. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use ICC/AS/Planning and Conducting a Meeting to reinforce this area of instruction.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done by observing participation in assignment.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT: Employment

TOPIC: Employment Terms and Definitions

ESSENTIAL ELEMENT(S): Common (2); T&I (2)

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify terms and definitions associated with employment and/or postsecondary training.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Introduction
Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Employment Terms and Definitions

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that when learning about any area of education it is important to know the terms and definitions associated with that area. By the end of the lesson, you will be able to identify terms and definitions associated with employment.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Employment Terms and Definitions as a guide, discuss each of the terms and their meaning. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Employment Terms and Definitions as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review several of the terms discussed in the lesson. Have students give the meanings.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT:	Entrepreneurship
TOPIC:	Entrepreneurship Terms and Definitions
ESSENTIAL ELEMENT(S):	Common (3); T&I (3)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate an understanding of concepts and skills associated with entrepreneurship.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify terms and definitions associated with entrepreneurship.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Introduction Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Entrepreneurship Terms and Definitions

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that when learning about any area of education it is important to know the terms and definitions associated with that area. By the end of the lesson, you will be able to identify terms and definitions associated with entrepreneurship.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Entrepreneurship Terms and Definitions as a guide, discuss each of the terms and their meaning. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Entrepreneurship Terms and Definitions as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review several of the terms discussed in the lesson. Have students give the meanings.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT:	Entrepreneurship
TOPIC:	What Is Entrepreneurship?
ESSENTIAL ELEMENT(S):	Common (3); T&I (3)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate an understanding of concepts and skills associated with entrepreneurship.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of entrepreneurship.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Introduction Introduction to Construction Careers/Common Essential Elements/Student Information Sheet/What Is Entrepreneurship?/Assignment Sheet/Am I an Entrepreneur?

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Discuss the meaning of entrepreneurship. Ask students go give examples of people they know who are entrepreneurs. By the end of the lesson, you will be able to demonstrate an understanding of entrepreneurship.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/What Is Entrepreneurship? as a guide, discuss what type of person might become an entrepreneur. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use ICC/AS/Am I an Entrepreneur? as independent practice.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through checking assignment sheet.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT: Entrepreneurship
TOPIC: Getting Started
ESSENTIAL ELEMENT(S): Common (3); T&I (3)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of how to start a business.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Introduction
Introduction to Construction Careers/Common Essential Elements/Student Information Sheet/Getting Started/Assignment Sheet/Starting Your Own Business

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Ask the students if they think it would be difficult to start a business. Have them discuss what they think an individual would need to know when starting a business. By the end of the lesson, you will be able to demonstrate an understanding of how to start a business.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Getting Started as a guide, discuss what you would need to know to start your own business. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use ICC/AS/Starting Your Own Business as independent practice.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through viewing student's participation in assignment.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT: General Shop Safety
TOPIC: Personal and Group Safety
ESSENTIAL ELEMENT(S): Common (4); T&I (4)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify safe working practices.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Introduction
Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Personal and Group Safety

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Discuss that safety is important in that safety affects everyone. Individual safety is a part of overall group safety. By the end of the lesson, you will be able to identify safe working practices.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Personal and Group Safety as a guide, discuss safety practices. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use ICC/AS/Personal and Group Safety as independent practice.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT:	General Shop Safety
TOPIC:	Work Safety in the Shop
ESSENTIAL ELEMENT(S):	Common (4); T&I (4)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate a knowledge of safe working practices.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Introduction Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Work Safety in the Shop

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that safety is important in that safety affects everyone. Accidents often happen in the shop. Each student must learn to follow safety procedures in order to protect his/herself and others. By the end of the lesson, you will be able to demonstrate a knowledge of safe working practices.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Work Safety in the Shop as a guide, discuss safety practices. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Work Safety in the Shop as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT: General Shop Safety
TOPIC: Fire Safety
ESSENTIAL ELEMENT(S): Common (4); T&I (4)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate a knowledge of fire safety.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: General Construction Trades: Introduction
Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Fire Safety

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Fire safety is an important aspect of general shop safety. Being prepared is an important part of being safe. By the end of the lesson, you will be able to demonstrate a knowledge of fire safety.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Fire Safety as a guide, discuss safety practices. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Fire Safety as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT:	General Shop Safety
TOPIC:	Safety with Hand and Power Tools
ESSENTIAL ELEMENT(S):	Common (4); T&I (4)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate skills in working safely and apply safety to the use of hand and power tools.

TOOLS AND EQUIPMENT:	Prepare a display of tools.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	General Construction Trades: Introduction Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Safety with Hand and Power Tools

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

All aspects of safety are important. However, when working with hand or power tools there are specific safety practices which should be observed. By the end of the lesson, you will be able to demonstrate skills in working safely and apply safety to the use of hand and power tools.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Safety with Hand and Power Tools as a guide, discuss safety practices to be used when working with any type of tool. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Safety with Hand and Power Tools as practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review the main points of the lesson.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT:	Human Relations and Personality Development
TOPIC:	Terms and Definitions for Human Relations and Personality Development
ESSENTIAL ELEMENT(S):	Common (5); T&I (5)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with human relations and personality development.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to identify terms and definitions associated with human relations and personality development.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Self-Appraisal Instructional Guide Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Terms and Definitions for Human Relations and Personality Development

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that when learning about any area of education it is important to know the terms and definitions associated with that area. By the end of the lesson, you will be able to identify terms and definitions associated with human relations and personality development.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Terms and Definitions for Human Relations and Personality Development as a guide, discuss each of the terms and their meaning. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Terms and Definitions for Human Relations and Personality Development as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review several of the terms discussed in the lesson. Have students give the meanings.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT:	Human Relations and Personality Development
TOPIC:	Getting to Know Yourself
ESSENTIAL ELEMENT(S):	Common (5); T&I (5)
TYPE OF LESSON:	Cognitive
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with human relations and personality development.
SPECIFIC OBJECTIVE(S):	Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of the importance of getting to know him/herself.

TOOLS AND EQUIPMENT:	No special tools or equipment are required.
MATERIALS:	No special materials are required.
TEACHING AIDS:	No special teaching aids are required.
REFERENCES:	Self-Appraisal Instructional Guide Introduction to Construction Careers/Common Essential Elements/Student Information Sheet/Getting to Know Yourself/Assignment Sheet/Self-Concept Checklist

INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
How well do you think you know yourself? Do you think that the better you understand yourself, the better you will understand others? By the end of the lesson, you will be able to demonstrate an understanding of the importance of getting to know yourself.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Getting to Know Yourself as a guide, discuss information provided. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use ICC/AS/Self-Concept Checklist as independent practice.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through checking assignment sheets.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS:

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LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT: Personal and Business Management

TOPIC: Terms and Definitions for Personal and Business Management

ESSENTIAL ELEMENT(S): Common (6); T&I (6)

TYPE OF LESSON: Cognitive

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of the concepts and skills related to personal and business management.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to identify terms and definitions associated with personal and business management.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Economic and Societal Factors Instructional Guide
Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Terms and Definitions for Personal and Business Management

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)

Discuss that when learning about any area of education it is important to know the terms and definitions associated with that area. By the end of the lesson, you will be able to identify terms and definitions associated with personal and business management.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)

Using SIS/Terms and Definitions for Personal and Business Management as a guide, discuss each of the terms and their meaning. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)

Use ICC/AS/Terms and Definitions for Personal and Business Management as independent practice.

EVALUATION/VERIFICATION

An informal evaluation of student learning may be done through scoring of assignment sheet.

SUMMARY/CLOSURE

Review several of the terms discussed in the lesson. Have students give the meanings.

THE NEXT LESSON IS:

LESSON PLAN

COMMON ESSENTIAL ELEMENTS

UNIT: Personal and Business Management
TOPIC: Budgets
ESSENTIAL ELEMENT(S): Common (6); T&I (6)
TYPE OF LESSON: Cognitive
UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of the concepts and skills related to personal and business management.

SPECIFIC OBJECTIVE(S): Upon completion of this instructional unit, the student(s) will be able to demonstrate an understanding of budgets and how they work.

TOOLS AND EQUIPMENT: No special tools or equipment are required.

MATERIALS: No special materials are required.

TEACHING AIDS: No special teaching aids are required.

REFERENCES: Economic and Societal Factors Instructional Guide
Introduction to Construction Careers/Common Essential Elements/Student Information Sheet and Assignment Sheet/Budgets

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INTRODUCTION/MOTIVATION/WARM-UP (FOCUS/DIRECT STUDENT'S ATTENTION TO THE CONTENT/PURPOSE OF INSTRUCTION/ACTIVITY)
Ask students if they always have enough money. Are they always able to buy what they would like? If given a plan which would allow them to purchase what they feel they need, would they use it? By the end of the lesson, you will be able to demonstrate an understanding of budgets and how they work.

TEACHER ACTIVITIES (PRESENTATION, DEMONSTRATION, LECTURE, MODELING, AUDIO/VISUALS, CHECK FOR KNOWLEDGE, AND RETEACH/EXTENSION)
Using SIS/Budgets as a guide, discuss the parts of a budget and how to plan a budget. Use individual and group questions to check for knowledge.

STUDENT ACTIVITIES (APPLICATION)
Use ICC/AS/Budgets as independent practice.

EVALUATION/VERIFICATION
An informal evaluation of student learning may be done through checking work on assignment sheet.

SUMMARY/CLOSURE
Review the main points of the lesson.

THE NEXT LESSON IS:

APPENDICES

APPENDIX A

MODIFICATION TECHNIQUES FOR SPECIAL POPULATIONS

ACKNOWLEDGEMENT

The Module 7 Overview of the Vocational Special Needs Teacher Training Curriculum has been reprinted with permission as this appendix. Teachers are encouraged to refer to the original publication to learn more about working with special needs populations. The character font size and line spacing have been changed in this appendix to save space.

The project was developed in 1987 by Craig R. Colby, Ed.D. of Texas A&M University. Linda H. Parrish, Ph.D., Texas A&M University, and Jerry L. Wircenski, Ph.D., North Texas State University, were the project directors.

The vocational special needs teacher training curriculum was developed pursuant to a contract with the Texas Education Agency's Vocational Education Special Projects. Contractors or grantees undertaking such projects under Agency sponsorship are encouraged to freely express their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Texas Education Agency position or policy.

This information is presented as an appendix to help Trade and Industrial teachers with planning the modification of instruction for special populations. Many of the concepts and ideas presented are sound practices to be used with normal populations.

The entire 10 module training curriculum is available through the University of Texas at Austin. The modules in the vocational special needs teacher training curriculum are as follows:

Module 1	How to Use the Modules
Module 2	Federal Legislation
Module 3	Learner Characteristics
Module 4	Vocational Assessment
Module 5	Coordinated Planning
Module 6	Interagency Cooperation
Module 7	Modifications
Module 8	Generalizable Skills
Module 9	Serving LEP Students
Module 10	Student Evaluations

CURRICULUM MODIFICATION

The term "vocational curriculum" can be defined as the organized content of a particular discipline which a student must master to attain an occupational goal. It involves the sum total of all experiences and learning activities encountered in the classroom. A curriculum is concerned with results. It encompasses "what is to be taught" and "what is to be learned" (Stern-Otazo, 1980; Goh & Stitlington, 1983).

As discussed in previous modules, each student has a mental capacity, physical skills, and various needs which vary from one individual to the other. In addition, students exhibit different learning styles. All good teachers recognize this and will work toward developing a classroom environment which is characterized by a deep respect for the learner, acceptance of student, fulfillment of individual needs, and individual development. This is what is meant by the teacher who has become "learner-centered" and not "content-centered" (Pine & Boy, 1977). Jones (1977) eloquently describes recognizing individual worth and individual development as being the basis for curriculum development as follows:

> **Individual development** as a basis for curriculum perspective would lead us to teach discovery of principles and sacredness of the individual personality. It would teach the learners to view themselves as self-actualizing individuals in a setting designed to support and encourage personal development to the ultimate of one's potential. Attempts to improve the local community would center around providing a richer and fuller life for personal growth and development. Good people make good communities, good states, good nations, and good world. By emphasizing development of individuals, such a curriculum would hope to plant the seed for a better world in the future.

Therefore, all learners should be perceived as a very "special" individuals who one day will take their place in society. It is the responsibility of educators to assist **all** learners (in spite of their shortcomings) to become productive members of society. This can be accomplished by helping each student establish attainable career goals and then providing meaningful experiences through which the student can achieve these goals. Every student should be treated with dignity, as an individual who has unique strengths and interests in life. It is not necessary or even realistic to expect every student to do and know all the same things. As stated by Jones (1977), "Learners should become worthwhile persons in their own right,...it is not necessary that they all become miniature images of the same pattern."

Purpose of Curriculum Modification

When working with students with special needs, a learner's curriculum may need to be modified or adjusted to take into account major differences which could be found among these individuals. The term "curriculum modification" can be defined as tailoring an existing curriculum to the unique needs of students as they pursue an occupational goal (Sarkees & Scott, 1985; Goh & Sitlington, 1983). However, it should be strongly emphasized that modifying a curriculum does not mean that an educator should lower or alter the standards of his or her program. What it does mean is that the Admission Review and Dismissal (ARD) Committee (for handicapped students) or coordinated planning team (for disadvantaged and LEP students) determines which essential elements in the regular school curriculum would be appropriate for a student's needs. The State Board Of Education Rules For Curriculum offers the following key points (Texas Education Agency, 1985):

1. For students with special needs, school districts shall provide modifications in methodologies, pacing, and materials to ensure that instruction is delivered, as appropriate, in the essential elements.

2. Students with special needs shall be instructed in those same essential elements in a manner appropriate to their needs.

3. School districts shall implement the provisions (under Chapter 75) in a manner which will enable all students to participate actively in a well-balanced curriculum and master, to the best of their abilities, the knowledge, skills, and competencies established through the essential elements.

4. Specialized personnel and regular program personnel shall be jointly responsible for the cooperative delivery of effective instruction in the essential elements, as appropriate.

It is important to re-emphasize that special needs students, as all students, have capabilities which widely vary. The challenge parents, educators, and vocational counselors face is to help each learner reach occupational goals which are within the student's potential.

The Curriculum Modification Process

In developing a meaningful and challenging vocational curriculum for a special needs learner, the ARD Committee or coordinated planning team should carefully review the student's vocational assessment information which consists of: (a) the student's capabilities, (b) parent and student interviews (including the career expectations of the learner), (c) the student's vocational interests and abilities, and (d) the teacher's informal behavioral assessments of the student.

After reviewing this information, the planning team can then work toward developing realistic and appropriate vocational goals for the student. Important items to consider when developing vocational goals include: (a) community employment needs, (b) vocational readiness skills, (c) multiple exit points (jobs that a learner can prepare for in the vocational program), and (d) entry-level competencies expected by employers for each of the exit points. In this way, the learner would be aware of realistic employment opportunities, specific skills needed for entry into a vocational program, and specific objectives which must be fulfilled in reaching an employment goal.

A number of special education curriculum models have been designed which take into account both the needs of a vocational program and the needs of the learner. The basic components which many of the designs have in common are as follows:

1. The importance of working with existing vocational curricula.

2. The importance of building upon the student's interests and competencies.

3. The identification of long range vocational goals and short range objectives--which are stated in measurable terms.

For the purpose of this overview, the competency-based curriculum modification model has been selected for discussion.

The Competency-Based Curriculum

Over the years, the concept of competency-based curriculum has increased in popularity largely due to the emphasis on accountability in education (Choate, et al., 1987). In addition, since the passage of P.L. 94-142, vocational educators have had to adjust their curricula to take into account the capabilities of special needs learners.

The underlaying principle behind the competency-based curriculum is to assist the student in becoming a more effective person. This entails helping the student develop skills or competencies which will promote employment opportunities and a higher self-esteem within the student (Brolin, 1976; Lippmann & Porter, 1976). The ability to succeed is what makes competency-based learning so valuable for students with special needs (Kok, 1978). With competency-based learning a student does not have to wait until the end of the program to experience success. The sequential steps called for throughout the program afford the possibility of success on a day-to-day basis (Lippmann & Porter, 1976).

The concept of competency-based learning is relatively simple. Based upon the learner's assessment information, the educator establishes specific goals (competencies) which will help the student "function adequately as a consumer, a producer, a learner, and a citizen" (Parnell, 1973). For example, in an auto mechanics class, the student's occupational program goals or competencies may include one or more of the following: (a) performing a simple lubrication, (b) repairing a tire, (c) changing the battery, (d) completing an engine tune-up, (e) completing a valve job, (f) fixing the carburetor, or (g) overhauling the engine. Next, the educator develops objectives and an individualized instructional plan for the student to follow. This individualized instructional plan includes: (a) an objective, (b) an introduction, (c) a learning activity, (d) a test/checklist, and (e) answers/feedbacks.

Therefore, in competency-based learning it is not necessary or even realistic for the instructor to expose every learner to all the aspects of a vocational program. Competency-based learning focuses on the quality of learning rather than the quantity of learning such that the student who has limited skills could still find employment (Kok, 1978).

Gills's Four-Step Model

An excellent competency-based paradigm or model which can be utilized by vocational educators to maximize a learner's vocational potential was developed by Douglas H. Gill (Sarkees & Scott, 1982). The design of Gill's model involves the use of four sequential steps and utilizes the regular vocational curriculum as a basis for the modification process.

Step one. The first step in Gill's model requires the educator to gain a clear picture of the existing curriculum any student would follow in a particular vocational program. Gill calls this step "Establishing the Curriculum Framework." The purpose of this step is to organize the existing curriculum in such a way that it can be modified. This step involves: (a) identifying the overall long range goals of the vocational program, (b) identifying and listing the short-term objectives that sequentially comprise each long-range goal, and (c) identifying the instructional units which comprise a sequence for attaining each short-term objective. An example of a curriculum framework which outlines an overall long range goal, short-term objective, and instructional units follows:

1. **Long range goal**: Given appropriate tools, equipment and materials, the student will be able to demonstrate instructor specified job entry level skills in the masonry area of construction trades at a comparable rate of time and accuracy to that found on the job.
2. **Short term objective**: The student will be able to demonstrate the basic skills of bricklaying.
3. **Instructional units**: Spreading mortar. Laying brick to a line. Building a brick corner. Cutting brick and block.

Once the long range goals, short term objectives, and instructional units have been outlined for a particular vocational program, the educator can begin the work of modification for a special needs learner.

Step two. Step two of Gill's four-step model, "Developing an Instructional Task Analysis," builds upon step one. The instructional task analysis lists the tasks that, when sequenced, make up the instructional unit. In this step the educator identifies the required tasks the student must perform, emphasizing what the student must do rather than what the student must read or write. An example of instructional tasks for one of the instructional units above follows:

1. **Instructional unit**: Spreading mortar.
2. **Instructional tasks**:
    - Mix mortar.
    - Identify and use trowel.
    - Identify and use mortar board.
    - Wet mortar board.
    - Place mortar on board.
    - Bunch mortar.
    - Load trowel.
    - Distribute mortar.
    - Furrow mortar.
    - Cut excess mortar.
    - Seat mortar to trowel.
    - Butter brick.
    - Butter head joint.
    - Lay one brick to another.
    - Identify and explain purpose of running half-bond.

Therefore, establishing the curriculum framework and required instructional tasks (task analysis) organizes the instructional process and prepares for the next step in the process.

Step three. The third step in Gill's four-step model represents the implementation stage. This step, "Developing the Curriculum Supplement," involves developing usable supplements for the existing curriculum. The curriculum supplement is designed to be used jointly by the instructor and the resource support person. The curriculum supplement is composed of two major parts: (a) the Learning Plan and (b) the Supplemental Learning Plan.

The Learning Plan is used primarily by the instructor and consists of the following four basic parts:

1. Instructional unit
2. Instructional task
3. Performance-based task activities
4. Performance-based task check

The instructional unit and instructional task are components of the curriculum framework. The performance-based task activities describe for the instructor those task elements the student will do. The performance-based task check is a measurement of the student's ability to master the task at hand.

The Supplemental Learning Plan was developed for use primarily by special needs support personnel and consists of the following six basic parts:

1. Instructional unit

2. Instructional task

3. Task terminology

4. Essential math operations

5. Coordinated movements

6. Related concepts

The purpose of the Supplemental Learning Plan is to identify basic knowledge (task terminology, essential math operations, important concepts) and prerequisite skills (coordinated movements, related concepts) the learner must posses in order to complete an instructional task. The Supplemental Learning Plan can be very useful in helping the resource teacher and instructor identify those areas where instruction support may be needed. It is, therefore, very important that the Learning Plan and Supplemental Learning Plan be developed by the instructor, special education teacher, or support/resource teacher for each instructional task. In this way, if a learner has difficulty mastering a specific task, individualized activities can be developed by selected individuals to help the student resolve the problem.

Step four. The fourth and final step of Gill's model is the development of an individualized student module. The student's module is created from the Learning Plan and Supplemental Learning Plan and is the culmination of the curriculum modification process. The student's module consists of the following four components (Goh & Sitlington, 1983):

1. **Word section:** Includes terms identified on the supplemental learning plan, along with definitions of each term.

2. **Job tasks:** Definition of each step in the job. This appears in the student module under the heading "What You Do."

3. **Illustrations of job tasks:** The illustrations help clarify the job steps and should be clear and precise, without being complex.

4. **Evaluation procedures:** Both enroute (formative) checkups and a final (summative) performance check are included to assess the learner's progress through the module.

The student's module is tailored to help meet the specific needs of a learner and serves as a guide to assist the student in achieving instructional tasks. Various ways in which a student's module can be individualized to take into account the various learner differences found in the training setting are as follows (Goh & Sitlington, 1983):

1. The amount of detail and illustrations can be varied to take into account learner differences in intellectual abilities and educational backgrounds.

2. The mode of presentation can be altered to meet the needs of learners with differences in learning styles (e.g. audio-cassettes can be added for auditory learners).

3. The amount of feedback from the module and instructor can be increased or decreased to match differences in motivation, perseverance, and tolerance levels.

In summary, Gill's four-step model is a competency-based process flowing directly from the regular vocational curriculum. The steps range from establishing a curriculum framework to developing an individualized student module. Gill's model is not designed to replace or lower the standards of the regular vocational curriculum. It is a systematic process by which a special needs student can achieve solid vocational goals through the cooperative support of vocational instructors, special educators, and support personnel.

Responsibilities of the Vocational Educator

The primary responsibility of the vocational educator in the curriculum modification process is to help the special needs student establish and reach realistic occupational goals. In an effort to accomplish this, the vocational educator must identify the following (Sarkees & Scott, 1985):

1. Pertinent information about what will be taught in a vocational program.

2. Necessary requirements for program completion.

3. Multiple exit points (jobs that the learner can prepare for in a vocational program).

4. Entry level competencies expected by employers for each of the exit points.

It is also the responsibility of every vocational educator to establish an effective and wholesome learning environment for their students. Providing this environment may involve modifying the vocational facility, equipment, tools and/or instruction. This information will be provided in the following section.

MODIFICATION OF THE LEARNING ENVIRONMENT

The term "learning environment" refers to both the physical and instructional setting of the vocational classroom/laboratory (Bell, 1984). It is the responsibility of each vocational educator to work at developing a learning environment which will contribute to the overall well-being and success of every student. The key factors found in a wholesome learning environment are those which promote:

1. **Safety, organization, and physical comfort.** In the vocational laboratory, it is absolutely crucial that each student abide by safety rules set by the instructor. In addition, the laboratory should be kept well organized and clean. A laboratory which is safe, well organized, and physically comfortable helps promote high morale and good work habits.

2. **Respect and acceptance**. Within an effective learning environment, students will show respect not only for the instructor but for each other as well. The instructor should be the student's best role model. The care and acceptance given by the instructor to each student (disabled or non-disabled) will go a long way in promoting peer acceptance, a positive attitude, and healthy self-esteem.

3. **Discipline.** A wholesome learning environment is one which promotes discipline and a positive self-concept within each student. Inappropriate behavior has the potential to seriously affect classroom safety, morale, and the overall learning process. Ways in which the instructor can help the student modify inappropriate behavior include: (a) utilizing the time-out technique, (b) developing student-teacher contracts, (c) ignoring negative behavior--whenever possible, and (d) rewarding appropriate behavior with approval and praise.

4. **Flexibility**. An effective learning environment is flexible and can adapt to a special student's unique needs (i.e., slower rate of learning, inability to access regular tools/equipment, or remedial needs in reading or math for instance). A flexible environment fosters individualized programs through which a special learner can develop marketable skills for employment.

Modifying Facilities, Equipment, and Tools

In the past, many special needs learners have been denied their basic right to a public education because of architectural barriers, nonadaptive facilities, equipment, and tools (Phelps & Lutz, 1977). However, federal legislation has done a great deal to provide equal access to educational programs for every learner. For example, according to Section 503 of the Rehabilitation Act of 1973, each federally funded program or activity in which a handicapped individual can enroll and profit must be made accessible to the student (Sarkees & Scott, 1985). In addition, the Carl Perkins Act of 1984 has emphasized the importance of providing supplemental services for special needs learners, which include the adaptation of facilities, equipment, curriculum, and instruction (Cobb & Kingburgy, 1985).

Modifying facilities. A barrier-free facility planned for safety, efficiency, and convenience is of vital importance to individuals with special needs--especially those who are in wheelchairs, on crutches, or have artificial limbs. According to Sarkees & Scott (1985), three major areas in which architectural barriers may be present at most vocational education facilities are:

1. **Getting to and entering the building** -- getting to the ground from public or private transportation; parking; negotiating parking lot pavement, curbs, walkways, ramps, and stairways; and entering exterior doors.

2. **Moving about inside a building** -- moving through corridors and hallways; moving from floor to floor; identifying and entering classrooms, laboratories, and auxiliary areas; moving through aisles and traffic lanes inside classrooms and laboratories.

3. **Using school fixtures, appliances, and study/work station area equipment** -- using restrooms, drinking fountains, vending machines, tools, machines, and work station apparatus.

In an effort to eliminate these barriers, vocational educators, planners, and administrators should contact the State Architectural Barriers Board or State Department of Education regarding the guidelines and standards that have been developed for compliance with federal mandates. The federal government has adopted the American National Standards Institute (ANSI) accessibility standards as its mandatory guidelines for removal of architectural barriers (Sarkees & Scott, 1985).

Modifying equipment and tools. Based upon the needs of each special learner, it may become necessary to modify existing equipment and tools to accommodate the special needs student. The degree of modification will depend upon the type and extent of each student's impairment. It should be remembered, however, that equipment should be modified only to the extent necessary to assist the student. Whenever possible, as the student generates competence in a learning task, the modified equipment should be replaced with regular equipment (Phelps & Lutz, 1977). The following are some general suggestions in which equipment and tools can be modified for specific classifications of special needs students (Phelps & Lutz, 1977; Sarkees & Scott, 1985; Stern & Gathercoal, 1986):

Important Note:	It is very possible that a number of these suggestions could apply to more than one category. Furthermore, some of these modifications may be applicable to disadvantaged and LEP students. This, of course, would depend upon the needs of the particular student.

Modifications for Orthopedically-Impaired Students

1. Work benches can be cut out so that wheelchair bound students can pull up close to the work surface.

2. Modify the height of workbenches, storage cabinets, table tops, etc. to make them accessible to wheelchair bound students.

3. A lap board can be fitted on the arms of the wheel chair to provide a work area.

4. Rearrange storage areas for tools and supplies to make them accessible and as near to the work station as possible.

5. Position bench-mounted power tools on the ends of benches.

6. Semistationary equipment should be put on variable height bases.

7. Modify machine controls so that they can be operated with prostheses such as an arm hook.

8. Replace cabinet knobs with levers or handles.

9. Convert knob-type ON-OFF switches to toggle switches, levers, or slide-adjustment mechanisms.

10. Provide an aid that increases mechanical advantage in manipulating controls.

11. Convert machines and equipment that have hand controls to the foot pedal type for students who have upper extremity disabilities.

12. Select machines that do not require two-handed operation, such as a radial arm saw instead of a table saw.

13. Place small parts of instruments on a foam pad to aid students in picking them up.

14. Select tools that require only one hand to operate, such as split screwdrivers, which hold screws and bolts for starting.

15. Provide holding devices such as vacuum vises, stationary vises, clamps, jibs, and fixtures that permit one-handed operation.

16. Provide tools that supply more mechanical advantage to loosen or tighten screws or bolts, such as a lever-type socket set or an offset screwdriver.

17. For students who have weak hands, increase the size of tool handles by replacing them with larger diameter handles or by enlarging them with tubing or tape wrappings.

18. Provide templates to aid drafting students who have trouble manipulating standard drafting instruments.

Modifications for Hearing-Impaired Students

1. Install a red light next to the on-off switch so that the student can tell when the machine is in operation.
2. Install amplification devices on auditory warning signals so that they can be heard by those with partial hearing.
3. Use visual timers in place of those that emit sounds.

Modifications for Visually-Impaired Students

1. Purchase commercially available measuring tools with raised or engraved markings that can be read by touch.
2. Purchase measuring devices that provide auditory signals.
3. Brailled tape or raised marks can be used on control dials and switches.
4. Enlarge markings on tools, tool holders, or machine controls.
5. Provide jigs, guides, and templates to aid students in positioning and guiding tools.
6. Identify controls by changing their size, shape, or texture.

Modifications for Mentally-Impaired Students.

1. Color code important parts of machines or equipment.
2. Devise jigs, fixtures, templates, and guides to simplify work task operations.

Modifications for Limited English Proficient Students

1. Utilize name placards (Spanish and English) for machines, tools, and equipment.
2. Color code or use symbols for dangerous machines. For example, one red dot could indicate a dangerous machine and two red dots could indicate a very dangerous machine.

A wide variety of specially designed aids, tools, machines, and equipment are commercially available to assist the special needs learner. Occasionally, this material can be paid for through vocational rehabilitation centers or the school's special education program. Information pertaining to manufactured devices can be found in school supply catalogs or in catalogs published by special institutes. A very comprehensive resource has been developed by the Wisconsin Studies Center, University of Wisconsin-Madison, entitled Tools, Equipment and Machinery Adapted for the Vocational Education and Employment of Handicapped People. In addition, information is available through the school's special education personnel and vocational rehabilitation counselors (Sarkees & Scott, 1985).

In conclusion, two educational topics have been presented which are **fundamental components** to the successful instruction of learners with special needs: (a) developing or tailoring an appropriate curriculum and (b) establishing a favorable learning environment. Within the final section of this Overview, basic principles will be presented which will address the actual instruction of special learners.

MODIFICATION OF INSTRUCTION

The primary purpose of this section is to provide the vocational educator with teaching strategies and techniques that will be useful when instructing students with special needs. It is important to remember that the methods and approaches used by educators when instructing non-special needs students may not be very effective with students with special needs (Gleiss-Monar & Sitlington, 1983). Therefore, individualizing instruction becomes vitally important in the successful instruction of special learners.

Within this section, the following topics will be discussed: (a) learning styles, (b) teaching strategies, (c) remediation techniques, and (d) Brown's 3-Cs Instructional Mode.

Learning Styles

Each special learner has unique needs and these needs affect how the student can best learn. For example, if a student is blind or has difficulty with "visual" learning, the instructor should stress the learner's sense of sight. Therefore, the manner in which a student with special needs learns ceases to be a preference, but becomes instead a necessity (Kok, Jernigan, & Hull, 1978). Further, one of the main philosophies behind individual learning styles is that learning should be a pleasant and successful experience. Educators, therefore, should adjust their style of teaching to allow students the benefit of learning in their preferred manner (Kok, Jernigan, & Hull, 1978).

Identifying a student's learning style.

The following are methods in which an educator can identify a student's learning style:

1. **Informal observation.** One of the simplest and possibly best ways to identify a student's learning style is through informal observation. By observing the student as he or she negotiates classroom/laboratory learning activities, the educator can collect valuable information with regard to the student's learning style. For example, the educator may observe that a disadvantaged student answers questions in class and does well with hands-on activities but repeatedly fails written exams. If the primary intent of the instruction is to reach vocational skills rather than reading and writing skills, the instructor could modify their style of teaching by allowing the student to take oral and/or hands-on exams (Kok, Jernigan, & Hull, 1978: Sarkees & Scott, 1985).

2. **Teacher consultation.** Consulting other teachers (i.e., special education teachers, resource room teachers, support personnel, paraprofessionals, and other vocational education teachers) can be an excellent source for information regarding a student's learning style (Sarkees & Scott, 1985).

3. **Student/parent interviews.** Interviewing the student and student's parents/guardians can result in valuable insights as to the student's best learning modes (Sarkees & Scott, 1985)

4. **Standardized inventories.** Standardized inventories provide an alternative for students who are shy or uncomfortable during a personal interview. Information received from interest, personality, and learning style inventories can provide valuable information with regard to the student's learning style (Kok, Jernigan, & Hull, 1978; Sarkees & Scott, 1985).

Teaching Strategies

Once the student's vocational goals, learning capability, and preferred learning style have been identified, the educator can begin to experiment with a variety of teaching techniques and instructional materials. When determining the teaching technique and instructional material best suited to meet a student's unique needs, it is important for the educator to be patient, open-minded, and flexible. Not every instructional technique and/or material can be used successfully with each learner (Sarkees & Scott, 1985). In addition, the educator should not hesitate to enlist the support of other instructors, school counselors, student aides, paraprofessionals, volunteers from the community, itinerant teachers, and/or interpreters. This pooling of efforts can result in increased student learning because of the variety of approaches and personal attention which can be brought to the classroom or laboratory (Harrington & Fardig, 1982).

The following are general guidelines and instructional techniques which an educator can use to help meet a special needs learner's unique needs and learning style:

1. **Orientation**. Students with special needs may need additional orientation with regard to: (a) the relevancy of their individualized goals, (b) class procedures, (c) safety, etc.

2. **Flexible pacing**. Students with special needs can exhibit different rates of learning. The educator should provide flexibility in pacing of instruction and assignments to meet the various needs of learners. In general, students with special needs should be individually paced to maintain their progress and interest, yet avoid the frustrations and failure undue pressure may cause (Harrington & Fardig, 1982; Sarkees & Scott, 1985).

3. **Demonstration.** Utilization of the demonstration method can be very effective in introducing a new skill to a learner with special needs.

4. **Breaking material into small distinct steps**. As a general rule, it is important for the educator to break a learning concept into small distinct steps. In this way, the educator can best identify where the student is experiencing difficulty.

5. **Positive environment and feedback**. In general, students with special needs lack confidence and a positive self-concept. This is primarily due to their not having had much success in life. In addition, the few successes special learners do have usually result in little, if any, positive reinforcement (i.e., praise, reward, and/or encouragement). Therefore, it is incumbent upon educators to create a positive, nonthreatening learning-environment for their students and to make generous use of positive feedback when the student experiences success. Constructive criticism should not be avoided; however, it should be given in a positive manner (i.e, students should understand that their behavior or product is what's being criticized and not their worth as a human being). Finally, all students must learn that mistakes and constructive criticism are a normal and expected part of life (Harrington & Fardig, 1982).

6. **Use of peer tutors, college students, and volunteers**. Use of peer tutors, college students, and volunteers can greatly assist a vocational educator's work with special learners by: (a) helping with individualized instruction, (b) providing positive role models, (c) increasing student participation, (d) increasing the special learner's success experiences, (e) increasing the student's confidence and self-esteem, and (f) improving the special learner's social and academic skills (Asselin & Anderson, 1986). In addition, peer tutors,

college students, and volunteers can receive teaching experience and the satisfaction of helping individuals with special needs progress.

7. **Flexible grouping**. The educator can integrate special needs learners into groups of various sizes (according to the student's goals, interests, or ability level) and utilize peer tutors, college students, and volunteers for assistance. According to Sarkees & Scott, grouping students has the following advantages: (a) it allows the teacher more time to work among the students, (b) it allows the teacher to individualize instruction, tasks, and assignments to meet the needs of students in a specific group, (c) it provides special needs learners with an opportunity to work with peers and establish positive interpersonal and working relationships with them, (d) it serves as a motivating factor for special needs learners because the individualized nature of the group work does not become threatening or frustrating but allows students an opportunity to work at their own pace through their strongest learning style, (e) it allows teachers to arrange for instruction for the entire class, small group discussions, project groups, and small remedial sessions so that instruction will be diversified and more meaningful for all students; and (f) it allows the teacher to modify the task or assignment for a small group of students with specific needs, as in the case of learners who have a physical disability (Sarkees & Scott, 1985).

8. **Providing field trips and job site visits**. Scheduled field trips and job site visits can give all learners a realistic first-hand look into the real world of work. By "shadowing" workers in a particular occupational area, students can gain helpful insights into their own career decision. In addition, a field trip or job site visit can be very motivational in that the student can readily observe how his/her vocational training will be used in the world of work (Sarkees & Scott, 1985).

9. **Use of media**. Utilizing media can embellish instruction by: (a) assisting the teacher in presenting the proficiency or skill requirements for a specific job, (b) reinforcing concepts presented in a classroom, laboratory, or demonstration activity, (c) providing a vehicle for special needs learners to show what they have learned, (d) providing a valuable source of remedial assistance, (e) providing simulated learning experiences, (f) allowing special needs students to learn through their strongest style, and (g) adding variety to the instructional program. Examples of media include: computer assisted instruction (CAI), 16 mm films, film strips, flip charts, overhead transparencies, tape recorders, records, posters, magazines, and diagrams (Sarkees & Scott, 1985).

10. **Use of student-teacher contracts**. Student-teacher contracts can be excellent tools in helping learners with special needs achieve their vocational goals. The following guidelines should be used in developing and implementing a student-teacher contract: (a) decide on the task or project, (b) specifically state the requirements, (c) determine the minimum acceptable accuracy, (d) set a time limit--initially, short assignments and short time periods are usually best, (e) identify consequences, (f) discuss contract with student and support personnel, (g) have all parties sign the contract, (h) positive reinforcement should be given if the terms of the contract are satisfactorily met, (i) uncompleted contracts should be analyzed by the teacher and student to determine the causes, and (j) develop new contracts cooperatively (Sarkees & Scott, 1985).

The following is a list of specific teaching strategies which educators can utilize when addressing the unique needs of handicapped students (Sarkees & Scott, 1985; Stern & Gathercoal, 1986; Tindall; 1980):

Important Note: It is very important to note that many of these teaching strategies could be used for all students. Appearing later in this Overview is a listing of instruction strategies which could be generic to all special needs students.

Instructing Students Who Are Mentally-Impaired

Involve as many different senses as possible in the learning process.

Use concrete specific terms rather than abstract terms. If necessary, have the student repeat the necessary information to you.

When giving written directions use lists instead of paragraphs. With regard to the student who can barely read, contact the remedial reading staff and arrange reading instruction. This instruction should focus on required reading for your course and that which is vital for employment.

Teach by demonstration (whenever possible). Don't hesitate to use hand-over-hand assistance in demonstrating how to use a tool or machine.

Allow time to practice machine or tool processes.

Break down complex operations into smaller tasks.

With regard to feedback, let the learner know what is wanted, and whether or not the student is achieving it. Give lots of positive reinforcement and encouragement. Nonverbal feedback is also helpful (i.e. touching the student or task, pointing, blocking or stopping an error as it is developing, and guiding the learner's movements). In addition, provide specific feedback with regard to the student's work. For example, the educator should say, "This piece was cut exactly to the right size," or "You put these two parts together correctly, " or use Mark Gold's expression "Try another way" (Gold, 1975).

Build the student's confidence by: (a) utilizing activities that will assure success, (b) assigning special tasks which will communicate with the educator's confidence in the student, (c) giving students an opportunity to correct their work and hand in a good project or assignment, and (d) displaying the student's good work.

In helping students with their ability to make correct discriminations, utilize Gold's "match to sample" technique in which the student is provided an example and a number of choices. The student will choose the correct alternative based upon the characteristics of the sample (Gold & Scott, 1971).

With regard to helping the student make correct discriminations when there are minimal differences between the stimuli, it may be necessary to: (a) present the choices in an easy form at first, (b) exaggerate attributes, (c) make the choices gradually harder, or (d) add and fade out color cue, add and then gradually remove large cue differences, or combine these two approaches.

Retention/memory can be improved by: (a) being systematic and presenting one new piece of learning at a time, (b) relating new material to familiar material, and keeping it practical and concrete, and (c) utilizing training techniques such as the total task method, chaining, modeling/demonstrating, and the structured overview (see Tindalls' Puzzled About Educating Special Needs Students).

"Generalizing", or having the student apply what has been learned to the contexts, can be improved by: (a) using examples from different relevant contexts and (b) practicing in settings similar to or exactly like those that will be encountered on the job.

Instructing Students Who Are Hearing-Impaired

In private, discuss with the student his/her ability to communicate with you (lip/speech reading, use of hearing aid, writing, signing, and total communication). An open discussion with the student which demonstrates your concern as an educator is an excellent beginning in building rapport.

Body language communicates messages too. Remember not to give mixed messages with your body language. Also, be alert to the body message the student is giving you (i.e., is he/she communicating tension, nervousness, avoidance, or confusion?)

If you will be working with an interpreter, do not instruct the deaf student as if he/she were a third party. Speak directly to the student. Also, remember that the interpreter is ethically bound to interpret everything you say. Therefore, sensitive or other issues concerning the student is best addressed in a meeting before or after class. If you are using media where the room must be darkened, focus a small lamp on the interpreter.

Maintain good eye contact with the student while speaking.

Speak slowly and clearly, pronouncing each word, but without exaggerating or over pronouncing.

Do not stand in front of a window while speaking. The light should be shining on your face and not the student's.

Try to rephrase a thought rather than saying the same words over again.

Encourage the student to read ahead on class material.

Try to keep the noise level down as much as possible in the class/laboratory.

Utilize handouts, the chalkboard, and other media.

Install a light to indicate when dangerous machinery is on.

Instructing Students Who Are Speech-Impaired

Always maintain eye contact and nod your head while the student is talking. This will help the student build confidence.

Work cooperatively with speech therapist and/or communication specialist to determine which technique will help most in assisting these students to communicate more effectively.

Encourage peer tutoring and small group activities to help the speech-impaired student develop interpersonal relationships with the other students.

Always allow sufficient time for the student to complete his/her sentence.

Try not to act uncomfortable when these individuals are communicating with you (i.e., discontinuing eye contact, shifting your position, clearing your throat). Your discomfort can be very discouraging to the student.

Do not require these individuals to present oral reports until they feel comfortable in the classroom environment.

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Model correct sentence structure for the speech-impaired student so he/she can follow your example.

Develop a list of technical terms used in your class and share these terms with the speech specialist to help the student become more confident n pronouncing terms used in class.

Instructing Students Who are Visually-Impaired

Orient the student to the classroom or laboratory before the course begins. Consistency and orderliness in the physical environment is very important to the visually-impaired student.

Arrange seating so the blind student will be able to hear the instruction and to allow for the best distance and lighting conditions for the partially sighted student.

Provide as many opportunities as possible for the visually impaired student to observe closely or to touch the materials.

Give materials and handouts to the student ahead of time. Also, a student peer can assist the visually-impaired student by making a carbon copy or a photocopy of their notes. Also, when possible, the educator can make a copy of their teaching notes. In this way, the visually-impaired student can review the materials with a tutor or have them transcribed into braille or taped.

It is important to gain and maintain the student's attention. Approval or disapproval will need to be verbalized.

Remember there is no need to talk louder to a visually-impaired student.

Rehabilitation counselors or special needs teachers can be useful resources in helping the student use commercial or modified learning aids or tools.

Tests may need to be prepared in large print, braille, on cassette tapes, or converted into exercises using the sense of touch. Also, it may be necessary to allow the student extra time to complete the test.

The tape recorder is the most frequently used technique for notetaking and preparing modified learning materials for the visually-impaired student.

The following is a sample of specially designed machines now available for the visually-impaired student: (a) OPTACON (Optical to Tacile Converter) allows students to read printed material, (b) STEREOTONER is similar to the OPTACON but converts the printed word into a tone pattern, (c) OPTOPHONE and VISOTACTOR convert print into sound, and (d) KURZWEL READING MACHINE which converts standard English text on a computer into easily comprehended speech.

A number of general tools or aids which can assist the student in reading or writing lessons for vocational courses follow: (a) braille, (b) large print, (c) tape recorders, (d) talking books, (e) raised letters, (f) slate and stylus (used to make notes), (g) braille writer (a 6-key manually operated machine), (h) typewriters, (i) braille verifier (types braille and regular copy simultaneously), and (j) signature guides.

Aids for mathematics and computer programming courses follow: (a) abacus design for the blind, (b) raised clock faces, (c) wire geometrical forms, (d) braille rulers, (e) raised-line checkbooks, (f) raised-line boards, (g) braille dominoes, (h) braille flash cards, (i) cubes with raised braille dots used for simple mathematical problems, (j) raised-line paper or graphs, (k) computer terminals that use braille printers, or those that type braille and conventional type simultaneously, and (l) talking calculators.

Aids used frequently in other vocational courses include: (a) braille maps, charts, diagrams, (b) self-threading needles, (c) wooden or cardboard models of specimens that other students see through microscopes, (d) braille micrometers and other shop tools that have special raised markings, (e) braille demo tapes to mark lab equipment and models, (f) light probes with audible sounds that check the operating status of machines, and (g) guides or templates to help students align objects properly.

Instructing Students Who Are Seriously Emotionally Disturbed

Consult with the student's parents, special education teacher, or counselor to determine whether any particular teaching techniques will help or hinder learning.

Try to understand the student. Disturbing behaviors are the outward sign of inner turmoil.

Go easy on bad days and avoid direct confrontations that would aggravate the situation.

Communicate acceptance to the student and a willingness to help him or her succeed in class.

Provide immediate feedback and reinforcement.

Establishing a rapport and trust with the student is important.

In the beginning of the semester, help the student gain confidence by giving him or her lessons in which success can be achieved in a series of small steps.

A measure of privacy when the student attempts a new task can ease his or her embarrassment at any awkwardness or ineptness.

Allow the student to correct mistakes prior to turning in an assignment or project to ease any pressure.

Help the student not to overreact to failure and praise him or her for continuing to try.

Cue appropriate behavior in a quiet, unemotional manner.

In resolving discipline problems: (a) do so in privacy, (b) focus on objective facts in a calm, supportive tone, (c) actively listen to the student, (d) after listening to the student, reflect on what has been said, by telling the student what you've heard, (e) ask the student if he or she has any ideas about solving the problem (encourage the student to be specific), and (f) conclude with a clear understanding of the changes, time-frame, and benefits which are expected.

In handling aggressive behavior: (a) try to remain calm and model the controlled behavior which you desire, (b) intervene by either separating the individuals involved and having them work on another activity or having them take a time-out in separate corners of the room, (c) if necessary, send an uninvolved student to the office to get help, either in talking to the students or in managing the class while the teacher talks to them, and (d) return to normal classroom procedure as quickly as possible.

Access professional collegues in special education evaluation, counselling, or therapy when the student's behavior appears to be in need of additional attention.

Instructing Students Who Are Orthopedically-Impaired

In general, students with physical handicaps will be intellectually capable and able to participate in vocational programs.

Make the necessary modifications in classrooms, laboratories, equipment, building accessibility, and lavatories.

For notetaking the student can: (a) use a tape recorder, (b) have a classmate slip a carbon copy into his/her notebook to duplicate notes, and/or (c) have the instructor prepare an outline of the lecture.

For exams the instructor can: (a) give oral exams, (b) have the student dictate answers into a tape recorder or to another student, or (c) utilize a typewriter/computer if the student is able to type/keyboard.

Give the student more time to complete homework assignments. Also, giving the student advance notification of assignments is helpful.

In the laboratory, pair the student with one or more capable students in the class.

Enlarge copies of frequently used charts and diagrams posted near the student's desk eliminates the necessity of paging through a book.

Instructing Students Who Are Other Health-Impaired

Allow the students sufficient time for rest.

Seat the student in the most convenient place for easy access to necessary facilities (hall, lavatory, chalkboard, laboratory work stations).

Allow the students to work on program requirements at his or her own pace.

Tape lectures so the student can listen to them at home.

Work cooperatively with the health team in order to learn more about the student's special needs.

Utilize community resources personnel (social workers and itinerant teachers for home-bound students) for delivery of materials, assignments, and handouts.

Instructing Students Who Have Specific Learning Disabilities

Use visuals and demonstrations as often as possible.

Use concrete examples whenever possible.

Provide student with an outline of what will be covered in class.

Make sure all printed materials are clear and readable.

If the student has a visual perception problem, allow him or her to tape-record assignments.

Allow students to take tests orally or in a mode that compliments their performance.

Present new information in small amounts.

Make sure that writing assignments are relevant to the content of the program.

Allow students a longer period of time to complete assignments, if necessary.

List assignments in steps.

Task analysis can be used to lower the frustration level of these learners.

Programmed instruction materials can be very effective with these learners.

The following is a list of specific teaching strategies which can be very useful when working with students who have **limited English proficiency** (Sarkees & Scott, 1985):

Recognize the student's cultural background and allow for the student's individual differences.

Encourage these students to bring dictionaries to class.

Use demonstrations and hands-on experience as much as possible.

Speak slowly and use simple vocabulary and grammar.

Use bright felt tip markers to mark important words, passages, or illustrations.

If possible, use a translator for important concepts.

Work closely with LEP support personnel.

Keep homework assignments short.

Check for comprehension by asking the student what you have said.

Use simple sentences when writing test items so the student can concentrate on answering the question rather than deciphering it.

And finally, with regard to the disadvantaged population, typically these individuals dislike school, lack motivation, and have a low self-concept or esteem. Therefore, an educator's personal commitment and high expectations for the student may be two of the biggest single factors which will make a positive difference in this individual's life. Additionally, an educator's good example (i.e., being patient, understanding, well organized, and a good manager) can be extremely valuable in motivating and positively shaping the student's behavior (Baca, 1981). Vocational education can offer a great deal to the disadvantaged student in terms of teaching academic and social skills relative to the student's potential employment (Baca, 1981). The following are additional techniques or teaching strategies which can be very useful when working with disadvantaged students (Baca, 1981):

The educator should seek to understand the student's educational and social background through: (a) assessment information, (b) interaction with former teachers, (c) discussions with counselors, and (d) visits with parents to ascertain the student's social limitations and home situation.

Basic math, communication, and social skills should be reinforced. Math skills can be reinforced through hands-on learning activities. Communication skills can be improved by tactfully correcting poor grammar, when appropriate, and by providing resources that encourage reading in job related interests.

Social skills such as getting along with people, grooming, proper dress, and respect for property and authority should be reinforced on a continual basis.

The importance of finishing school should be continually stressed. Relate acquisition of job skills to earn income.

Reinforce the student's feelings of self-worth by having high expectations for the student and by providing immediate reinforcement for work done well.

Simulate realistic job situations. All classroom and laboratory experiences should relate to employment in the occupation being studied.

Disadvantaged students (as all students) will typically react to the learning environment in a responsible and mature manner when they are treated with respect and as adults by the educator.

Classroom organization and discipline (being firm but not overbearing) are especially important. Generally, disadvantaged students want and need structure and discipline within their lives. Usually, these individuals will be responsive to and respect teachers who are firm, but sensitive.

Help the student develop employability and job coping skills (i.e., skills associated with finding, applying for, and retaining a job).

Help the student establish good work habits by keeping him or her involved with meaningful learning experiences. Each activity should have concrete learning objectives.

Disadvantaged students may need more encouragement to stay on task; however, they still should be required to complete all assignments (just as they will be required to do on the job).

Present instructions and information in clear, logical steps--building from the simple to the complex.

Technical terms should be communicated clearly and concisely and written in language which the students will understand.

Incorporate a variety of instructional methods in the curriculum (i.e., demonstrations, resource personnel, field trips, peer tutors, role playing, audio-visual aids, and on-site work experiences).

Present supplemental materials when appropriate. If such material is relevant to the acquisition of job skills, the student will not be humiliated by simplified material.

Highlight important parts of the student's text with a light marker to prevent the student from feeling overwhelmed with a larger volume of reading material.

Progress charts can be utilized to motivate disadvantaged students to master new skills.

Utilize flash cards (teacher made or commercial) to reinforce new terms and the use of tools and equipment.

When teaching special needs students, it is very important that instructors do not limit their instructional techniques. Therefore, the following abstract of instructional techniques or strategies has been prepared which could be considered generic to all special needs populations.

- Involve as many different senses as possible

- Use concrete terms
- Have students repeat important information
- Use lists rather than paragraphs for written directions
- Teach by demonstration
- Use hand-over-hand assistance when necessary
- Allow practice time
- Break complex operations into smaller tasks
- Provide immediate feedback
- Build confidence

- Help student make correct discriminations
- Help student with their retention/memory
- Help student generalize knowledge
- Build rapport
- Use appropriate body language
- Use appropriate techniques when working with an interpreter

- Maintain good eye contact
- Speak slowly and clearly
- Rephrase thoughts when necessary
- Encourage the student to read ahead
- Keep the noise level down
- Utilize various forms of media
- Use lights to indicate when dangerous machinery is on
- Work cooperatively with therapists
- Encourage peer tutoring
- Try not to act uncomfortable around special needs students
- Help students feel comfortable
- Model correct sentence structure
- Develop a list of technical terms for students and/or therapists

- Orient students before the course begins
- Provide handouts ahead of time
- Maintain student's attention
- Use tape recorders for note taking
- Try to understand the student
- Communicate acceptance
- Develop success experiences for the student

- Use appropriate behavioral management techniques
- Facilitate the students with their notetaking

- Facilitate the students with exams

- Pair students
- Enlarge charts and diagrams
- Use clear readable visuals frequently
- Provide an outline of material which is being taught

- Writing assignments should be relevant
- Use task analysis when necessary
- Allow for individual differences
- Encourage students to bring a dictionary
- Use felt tip marker to highlight important parts
- Do not make homework assignments too lengthy
- Use simple sentences when writing test items

- Reinforce basic education and work skills
- Reinforce the importance of finishing school
- Reinforce the student's feelings of self-worth

- Simulate realistic job situations
- Treat all students with respect and dignity
- Provide structure and organization
- Utilize progress charts
- Utilize flash cards

Remediation in the Basic Education Skills

It is very important to note that some students may need to acquire one or more basic education skills (i.e., mathematics, reading, writing, speaking, listening, interpersonal relations, and/or reasoning skills) to succeed in a vocational program. In addition, many employers will not hire an individual if he or she lacks these skills. Therefore, instruction in basic education skills may be necessary by the vocational educator. For information concerning basic or generalized skills instruction see Module 8.

Brown's 3-C Model

Brown's 3-C Model helps tie together many of the educational aspects discussed in this Overview. In general, Brown suggests that when delivering instruction to learners with special needs, the instructor can enhance the student's success rate and reduce feelings of frustration by considering the following 3-Cs of instruction: (a) correction, (b) compensation, and (c) circumvention (Brown & Dayser, 1982):

Correction. Providing feedback when the student's skills are being developed, thereby, correcting inappropriate behaviors immediately after they appear. Employing remedial reading and math services to enhance the student's ability to function within the program.

Compensation. Helping the student realize that each task represents only one of many activities contained in the course and that weaknesses in one area can often be offset by strengths in other areas. It should be communicated to the student that some tasks are inherently difficult and that he/she should not expect to achieve success immediately. Further efforts to compensate for the student would be to modify or adjust the delivery of instruction to extend over segments of several class periods. In addition, reinforcement during the early stages of instruction should be amply provided.

Note: Basically, "compensation" involves the instructor's modifications to the curriculum, learning environment, and instruction which has been discussed in this Overview.

Circumvention. If the vocational program is way out of reach for a student, for example, due to a course requirement of a relatively high level of reading skill, it may become necessary for the student to "circumvent" this difficulty by discussing alternate training programs with a vocational counselor.

Summary

Modification of curriculum, learning environment, and instruction can be an important key to successful employment training for special needs students. It requires that the instructor know his/her content completely, but the benefits to all students will likely be extraordinary.

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APPENDIX B

REFERENCES/RESOURCES

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APPENDIX C

ANSWERS TO ASSIGNMENT SHEETS

ANSWERS TO ASSIGNMENT SHEETS

AIR CONDITIONING AND REFRIGERATION

SAFETY: General Job Safety

1. Make a visual inspection to detect any unsafe defects in the ladder.
2. Face the ladder and keep both hands free to climb.
3. Lift with your legs bent so you lift with your legs and not your back.
4. Replace it.
5. They may impose fines on the employer.
6. One-fourth of the distance of the extended height of the ladder.
7. Have no more tools and materials on the scaffold than needed. Maintain scaffolds in a safe condition. Wear hard hats. Never work on scaffolds in bad weather. Do not use makeshift substitute scaffolds.
8. Because extra force needed to make dull tools cut may cause an accident.

SAFETY: Hand Tool and Power Tool Safety

1. The ball-peen hammer
2. Near the end of the handle
3. They should be ground off
4. Because more force must be used to make the cut
5. Make a visual inspection of it.
6. Goggles or face shield
7. Disconnect the machine from the power circuit
8. Double insulated
9. They should be stored in a dry location where they will not fall

SAFETY: Electrical Safety

1. (a) Use only one hand inside the equipment.
   (b) Check suspected defective equipment with power off.

2. (a) Disconnect equipment from power source

    (b) Don't touch the victim until he or she is free from the electrical equipment.
    (c) Call an emergency service unit (EMS).
3. An energized circuit
4. A nonconductive object

INTRODUCTION TO CAREERS IN AIR CONDITIONING AND REFRIGERATION: Customer Relations

1. To give a positive image of your company and to avoid embarrassment
2. Initiative, resourcefulness, and honesty
3. Do not argue with them. Just answer direct questions in an honest, friendly way.
4. Be especially courteous and show great concern for the customer.
5. Find another job and resign.
6. Inability to get along with others.
7. Through new experiences.
8. A businesslike attitude.
9. Our attitudes.

INTRODUCTION TO CAREERS IN AIR CONDITIONING AND REFRIGERATION: Occupational Outlook

1. Condensing units, evaporators, motors, and compressors
2. Repair shops, building construction job sites, homes, offices, and industrial buildings
3. Testing thermostats, relays, and compressors and maintenance such as overhauling compressors
4. (a) working in high places
    (b) lifting heavy equipment
    (c) using welding equipment
    (d) working around electrical equipment
5. Organizations that operate large air-conditioning, refrigeration, or heating systems; local retail dealers; and cooling and heating contractors
6. Employment will increase at about the same rate as the average for all other occupations
7. Because it may be more convenient to perform maintenance or repair operations there
8. 144 hours
9. Becoming a supervisor or opening up a new contracting business
10. From $12.00 to $15.00 in the 1980s.

INTRODUCTION TO AIR CONDITIONING AND REFRIGERATION: Understanding Basic Electricity

1. Direct current flows in a path continuously in the same direction, while alternating current changes direction at regular intervals.
2. It is more efficient because of its continuous flow at the same value.
3. It can be moved over long distances by using transformers and has more widespread applications at a much lower cost.
4. 120 times
5. Voltage

INTRODUCTION TO AIR CONDITIONING AND REFRIGERATION: Hand Tools

1. I
2. G
3. O
4. H
5. N
6. P
7. E
8. B
9. A
10. F
11. L
12. D
13. C
14. J
15. K
16. M

INTRODUCTION TO AIR CONDITIONING AND REFRIGERATION: Refrigerant Tools and Equipment

1. D
2. F
3. E
4. A
5. B
6. C

INTRODUCTION TO AIR CONDITIONING AND REFRIGERATION: Materials Used in Air Conditioning and Refrigeration

1. H
2. K
3. E
4. G
5. F
6. C
7. A
8. B
9. D
10. I
11. J

INTRODUCTION TO AIR CONDITIONING AND REFRIGERATION: Understand the Basic Concepts of Refrigeration

1. Sensible, latent, and total
2. By removing or absorbing latent heat
3. By removing the sensible heat
4. Mixed with type-1 in the same cooling unit to give better efficiency
5. Through tables provided by the building industry
6. Do not inhale fumes or allow the skin to come in contact with refrigerants.
7. (a) Store them in horizontal positions
    (b) Fasten them securely with blocks
    (c) Do not allow them to roll against each other
    (d) Never store them near inflammable substances
8. (a) Use correct regulators and gauges with proper refrigerant cylinders
    (b) Use tools provided by the refrigerant manufacturer only.
    (c) Use cylinders only for what they are intended.
    (d) Gases should not be mixed in a cylinder.
    (e) Never overfill a cylinder
    (f) Avoid using a sling or lifting magnet.
    (g) Keep cylinders capped when they are not in use.
9. A thermometer
10. Noncorrosive to metal, a low boiling point, a high latent heat value, and nontoxic
11. Freon-12 and Freon-22
12. Methyl chloride
13. Slowly

FUNDAMENTALS OF AIR CONDITIONING AND REFRIGERATION: Effects of Atmospheric Conditions on Air Conditioners

1. The amount of moisture in the air
2. The percentage of moisture the air is capable of holding at a given temperature
3. When circulation improves, evaporation increases.
4. (a) heat of melting or fusion
   (b) heat of vaporization
5. Latent heat of melting or fusion
6. Latent heat of vaporization
7. Evaporation, radiation, and convection
8. Heat is removed from the body as perspiration is changed into vapor.
9. Heat rays move from your body to other matter.
10. Heat flows from a hot surface to a surface containing less heat.
11. When heating the air to normal room temperature
12. To add moisture to the air
13. The calibrated dial of a humidistat
14. To the distribution pan, on to the evaporator, and out the drain
15. 30 pints
16. Cold air
17. Humid air passes through the condenser coils, and the moisture moves on out the drain.

FUNDAMENTALS OF AIR CONDITIONING AND REFRIGERATION: How Does the Compression System Operate?

1. The compressor creates a high-pressure area when it discharges high-pressure gas from the discharge valve. Since refrigerant always moves from a high-pressure location to a lower-pressure location, it moves from the compressor-discharge side to the low-pressure suction-valve side.
2. Rotary, centrifugal, and reciprocating
3. Compared to open types they are small and compact, and they are durable and efficient in operation.
4. It allows low-pressure refrigerant vapor from the vaporator to enter the compressor.
5. It allows high-pressure gas to leave the compressor and move to the condenser coil.
6. (a) They can run on low speed when cooling demands are light, or medium to save energy.
   (b) They are more effective dehumidifying a house than single-speed units.

7. The centrifugal compressor.
8. The entire compressor must be replaced.
9. Requirements for cooling or freezing and type of refrigerant to be used

FUNDAMENTALS OF AIR CONDITIONING AND REFRIGERATION: How Do Electric Motors Operate?

1. By attraction and repulsion between magnetic poles of a stator and the rotor.
2. The induction motor
3. A squirrel-cage rotor and stator with two field windings--a starting winding and a running winding
4. It starts by attraction and repulsion and runs by electromagnetic induction.
5. Starting and running windings in the stator and a squirrel-cage rotor with a centrifugal switch mounted on the rotor
6. The capacitor is in series with the starting winding, so as soon as the motor is turned on the capacitor assists the motor in starting. When the motor speed reaches 1,725 to 1,800 RPM, the centrifugal switch cuts out the starter winding and the motor runs on the winding until it is turned off.
7. By increasing the number of poles
8. (a) starting winding
   (b) running winding
9. An armature
10. Centrifugal type
11. Because it uses a wire-wound armature instead of a squirrel-cage rotor like an induction motor uses

FUNDAMENTALS OF AIR CONDITIONING AND REFRIGERATION: How Do Electrical Controls Operate?

1. To ensure that electric motors operate in the safest and most efficient manner possible
2. To protect the switches and the motor
3. When an internal component like a motor winding burns out
4. To act as circuit breakers to keep the motor winding from burning out
5. A relay
6. When using single-phase motors that are not over 5 HP.
7. As "normally open" or "normally closed"

8. A sufficient magnetic field at the rated voltage to operate the switch contact points efficiently.

FUNDAMENTALS OF AIR CONDITIONING AND REFRIGERATION: Air Conditioning Requirements for Ventilation

1. From a high-pressure area to a low-pressure area
2. Any air passage that delivers air to living areas
3. In a counterclockwise direction
4. The pressure difference in the system is increased
5. The fresh air is conditioned and mixed with the recirculated air.
6. Anything faster than 25 feet per minute
7. Through the design of the ducts and outlets
8. The drafts are diffused by reflecting against the walls, and the air gradually falls to the level of the occupants.
9. Install an air-cleaning system.

ANSWERS TO ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

SAFETY: General Safety

1. They might be jarred loose or collapse under the additional weight.
2. acid
3. serious damage to the blood, lungs, kidneys, and gastrointestinal system
4. skin contact
5. a NIOSH-approved respirator
6. Immediately check the seal, the filter, and the cartridge, and replace if needed.
7. the use of power equipment with noise levels in excess of NIOSH standards (currently 90 decibels)
8. the type of noise, the frequency of the noise, and how well they fit the individual
9. when there is a possibility of an eye injury from flying particles, chips, and caustic materials
10. (1) goggles
    (2) face shields
11. hard hats and hard-toed shoes
12. so you can see any cracks or flaws that might develop
13. near energized electrical equipment
14. The base of the ladder should be one-fourth of its working length away from the wall or support.
15. toward the ladder
16. during storms or high winds, or when scaffolds are covered with ice or snow

SAFETY: Handling and Storage

1. while materials are being handled
2. when materials being handled are heavy or sharp or likely to cause damage if dropped
3. the hands and the legs
4. at a given signal
5. only authorized persons

6. when carrying, lifting, or moving objects that are sharp, splintery, or hazardous to bare hands

7. rings

8. a squatting position

9. in glass containers in low locations, such as bottom shelves

SAFETY: Hand and Power Tool Safety

1. in a sheath or tool belt

2. because forcing a dull cutting tool often causes accidents

3. (1) missing the chisel and hitting a finger or hand
   (2) when particles from mushroomed heads fly off

4. flat, dry, and slightly rough

5. goggles

6. during removal, replacement, and sharpening of the blades

7. a respirator

8. Since the cement mixer is often top-heavy, it should be on level ground and in a stable position.

9. It is hard to control on slopes or when trying to stop.

INTRODUCTION TO CAREERS IN BRICKLAYING/STONE MASONRY: Careers in the Masonry Field

1. walls, walks, patios, partitions, fireplaces, and other structures

2. limestone, granite, and marble

3. churches, hotels and offices; also on houses where stone is plentiful

4. mortar

5. filling cracks with mortar or removing and replacing damaged brick or stone

6. in businesses operated by trade, building, or general contractors

7. three years of on-the-job training and 144 hours of classroom instruction

8. at least 17 years old

9. Growth will be slower than that of other industrial occupations.

10. less likely to be injured

11. long periods of standing, kneeling, or stooping, heavy lifting; injuries from hand tools, bricks, and stones; falls from scaffolds; few job openings;and lost time due to poor weather conditions.

BEING YOUR OWN BOSS: Setting up a Masonry Business

1. sole ownership
2. One person supplies the capital, and one runs the business.
3. from the Internal Revenue Service
4. the taxable wage base of a quarter (three months)
5. It covers liability if a worker is injured on the job. This may include driving to and from the building site.
6. The owner can pay cash for materials and not have to pay interest. Materials can be purchased with cash discounts, and timesaving equipment can be brought.
7. a two-way radio or CB
8. scheduling problems
9. draw up a binding contract or agreement
10. so the risk to the lending institute is less
11. late material deliveries

BEING YOUR OWN BOSS: Human Relations in a Business

1. the person's experience, attitude and abilities
2. state employment agencies, private employment agencies, recruiting firms, unions, and various social service organizations
3. through current employees
4. check their backgrounds
5. This gives both you and the applicant a chance to ask and answer questions about the job.
6. compile and review all information
7. an orientation period
8. the job responsibilities
9. competence, patience, organization, the ability to communicate, and a desire to support the trainee
10. so employees will form safety habits that may save time, expense, and suffering

11. (1) satisfaction in the job itself
    (2) pride in co-workers
    (3) acceptance of pay policies and promotion opportunities
    (4) a feeling of belonging to the company

12. Productivity drops

13. high employee turnover, complaints, absenteeism, and low productivity

INTRODUCTION TO BRICKLAYING/STONE MASONRY: Trowels, Hammers, Chisels, and Mixing Tools

1. J
2. I
3. H
4. G
5. D
6. C
7. B
8. A
9. K
10. E
11. F

INTRODUCTION TO BRICKLAYING/STONE MASONRY: Measuring and Leveling Tools

1. B
2. C
3. D
4. A

INTRODUCTION TO BRICKLAYING/STONE MASONRY: Heavy Masonry Equipment

1. A
2. B
3. E
4. D
5. C
6. F

INTRODUCTION TO BRICKLAYING/STONE MASONRY: Materials Used in Bricklaying/Stone Masonry

1. B
2. D
3. G
4. F
5. H
6. E
7. A
8. C

INTRODUCTION TO BRICKLAYING/STONE MASONRY: Mathematic Skills Used in Bricklaying/Stone Masonry

1. B
2. D
3. E
4. C
5. A

FUNDAMENTALS OF BRICKLAYING/STONE MASONRY: Reading Drawings and Blueprints

1. both short and long dashes
2. to indicate the outside borders and edges or lines that are visible within the object
3. to allow a space for dimension numbers
4. to identify numbers, notes, or references with a particular line, opening, or detail
5. break lines
6. phantom lines
7. when there is enough room on the drawing to show a complete object
8. those that show the openings in walls and the materials to use
9. Sheets are added that are drawn at a larger scale.
10. a cutaway of an object, building, or part of a building
11. the true shape of an object and its relationship to other parts
12. the dimensions of the unit in question

FUNDAMENTALS OF BRICKLAYING/STONE MASONRY: Using Masonry Ties

1. The ties have a smaller gage.
2. to attach brick veneer to backing walls
3. with eightpenny nails
4. to attach brick veneer to concrete walls, columns, or beams
5. either copper or zinc-coated steel
6. because sheathing is not strong enough to hold the nail in place

FUNDAMENTALS OF BRICKLAYING/STONE MASONRY: Using Reinforcing Bars

1. compressive and lateral
2. the weight of the contents of a building
3. the resistance that occurs when a force is applied against a structure
4. The complete unit has a tendency to shorten.
5. shear
6. so that tensile and shearing stresses may be carried

7. the same as that used for other types of brick construction

8. before construction begins

9. maximum bond and compressive and shearing strengths

10. by tapering the bed of mortar

11. (1) low-lift grouting
    (2) high-lift grouting

12. dry mortar

13. when a brick is shoved against the next brick to leave the headjoint full of mortar

14. by feeding small amounts of grout at one time

FUNDAMENTALS OF BRICKLAYING/STONE MASONRY: Basic Construction Processes

1. bricks that are placed lengthwise on a wall with the longest edges parallel to the face of the wall

2. one that is placed in a vertical position with the face of the brick facing the front of the wall

3. one of the continous horizontal layers of units that is bonded with mortar

4. the vertical, longitudinal joint between wythes of masonry

5. an English bond

6. It is poured into the cavity or collar joint between wythes of masonry.

7. (1) running bond
   (2) common or American bond
   (3) Flemish bond
   (4) English bond
   (5) stack bond

8. (1) tool
   (2) trowel

9. the weathered joint

10. when a brick is set on edge with the end toward the front of the wall

11. the horizontal layer of mortar on which a masonry unit is laid

12. a hairline crack

ANSWERS TO ASSIGNMENT SHEETS

CARPENTRY

SAFETY: Ladder Safety

1. when it has developed a defect, and it is no longer strong or safe to use.
2. because paint might conceal breaks, cracks, or other defects
3. (1) linseed oil
   (2) clear shellac
   (3) varnish
4. up and down
5. They should be surrounded by barricades or guardrails.
6. The doors should be locked or blocked.
7. It should rest against a 2" x 4" nailed across the opening, not against the sash.
8. It should be anchored at both the top and bottom to prevent it from being blown down.
9. toward the ladder
10. because they might fall on someone below the ladder
11. never more than one arm's length
12. in containers fitted with hooks or handles, and hung from the ladder rungs
13. at a distance not to exceed one-quarter of the ladder's full length
14. on a line or hoisted mechanically
15. You may lose your balance easily.

INTRODUCTION TO CAREERS IN CARPENTRY: Careers in Carpentry

1. the types of material required, the dimensions of the structure, and the location of structural parts
2. (1) acoustics
   (2) bridges
   (3) shipbuilding
3. (1) rough carpenters
   (2) finish carpenters
4. a finish carpenter
5. new construction

6. over a million

7. at least 17

8. four years

9. They represent about 50 percent of journeyman rates.

10. More advanced positions are carpenter foreman, job superintendent, and general superintendent.

11. because carpenters are more familiar with the entire construction process

12. dangers from falls, cuts, and the use of power equipment--poor weather or material shortages may cause temporary layoffs.

13. creative, vigorous activity and better wages than in most other building trades

14. the United Brotherhood of Carpenters and Joiners of America

15. cement finishers, plumbers, electricians, steelworkers, and bricklayers

INTRODUCTION TO CAREERS IN CARPENTRY: House Planning

1. materials to use, timesaving methods and personnel for certain jobs

2. This keeps a good relationship between the home buyer and those involved in the construction project, such as architects and contractors.

3. as a challenge

4. distances from school and work, environmental conditions, and the danger of flooding

5. when a person other than the builder owns the land on which a structure is to be built

6. to see that there are no mortgages, liens, delinquent taxes, or other conditions that might threaten legal ownership

7. a building permit

8. water and electricity

9. (1) industrial
   (2) commercial
   (3) apartment
   (4) residential

10. glass, plumbing, electricity, gas lines, sewage systems, and fencing on property

BEING YOUR OWN BOSS: Building Contractors and Types of Construction

1. sole ownership
2. responsibilities, liabilities, work and profits
3. One person supplies the capital, and the other person runs the business.
4. business and personal income
5. an attorney
6. They build first, then try to find a buyer.
7. speculative building
8. building for a particular person, persons, or firm
9. because every detail must be covered to the customer's satisfaction before construction begins
10. the time and effort spent on making estimates and submitting bids
11. They may pay a percentage during certain stages of construction or pay the complete amount after completion.
12. by repairing existing structures

BEING YOUR OWN BOSS: Setting Up a Construction Business

1. years of work experience, technical training, and financial statement
2. zoning laws
3. from the Internal Revenue Service
4. on forms submitted with social security and federal income taxes withheld from employees
5. if it has paid wages of $1,500 or more in any calendar quarter and has had one or more employees on at least some portion of one day in each of 20 or more calendar weeks
6. the taxable wage base of a quarter
7. It covers liability if a worker is injured on a job. This may include driving to and from work.
8. when financing is obtained from various lending institutions
9. the completion of the project and payment of all workers, material suppliers and subcontractors
10. completion of the job
11. It freezes construction funds held by the owner or lender until a suit is filed or money claims are settled.

12. the price of the completed project, terms of payment, services and specifications, construction time, liabilities, and guarantees

13. (1) lump-sum contract
(2) cost-plus contract

14. It means the contractor does not have to keep a backlog of money or have to secure loans.

15. The builder can pay cash for materials and labor and not have to pay interest. Materials can be purchased with cash discounts, and timesaving equipment can be bought.

16. a two-way radio

17. scheduling problems

INTRODUCTION TO CARPENTRY: Tools and Equipment

1.	E	6.	J	11.	D
2.	K	7.	A	12.	H
3.	O	8.	N	13.	B
4.	F	9.	M	14.	G
5.	I	10.	C	15.	L

INTRODUCTION TO CARPENTRY: Building Materials

Evaluated to the satisfaction of the instructor.

INTRODUCTION TO CARPENTRY: Carpentry Terminology

ACROSS		DOWN	
2.	SPAN	1.	EAVES
3.	CASING	2.	SHINGLES
5.	PITCH	4.	DOORJAMB
7.	OVERHANG	6.	CORNICE
10.	RISE	8.	GABLE
11.	BEVEL	9.	HEADER
12.	JOIST	13.	VALLEY
15.	BEAM	14.	SUBFLOOR
17.	PLUMB	16.	MOLDING
21.	FOOTING	18.	STUD
22.	DRYWALL	19.	INSULATION
24.	GRAIN	20.	RAFTERS
25.	GRADE	23.	BRACE
26.	JAMB		
27.	BEARING		
28.	FLASHING		
29.	SEASONING		

FUNDAMENTALS OF CARPENTRY: Introduction to Blueprints in Carpentry

1. F
2. T
3. T
4. T
5. T
6. F
7. T
8. F
9. T
10. T

FUNDAMENTALS OF CARPENTRY: Floor Framing

1. Sill
2. Bridging
3. Foundations
4. Stud
5. Joists

FUNDAMENTALS OF CARPENTRY: Wall Framing

1. A
2. C
3. D
4. E
5. F
6. B
7. L
8. K
9. H
10. I
11. G
12. J

FUNDAMENTALS OF CARPENTRY: Roof Construction

1. D
2. G
3. C
4. A
5. F
6. B
7. E

ANSWERS TO ASSIGNMENT SHEETS

RESIDENTIAL ELECTRICIAN TRADE

SAFETY: Electrical Safety Terms and Definitions

	ACROSS		DOWN
1.	Ground	2	Dead
4.	Approved	3.	Qualified
6.	Safety	5.	Overload
8.	Modification	7.	Accident
11.	Live	9.	Defective
12.	Electrical	10.	Circuit

SAFETY: Electrical Accidents

Examples given by students will be evaluated to the satisfaction of the instructor.

1. Any four of the following: human failure, failure to make repairs on faulty equipment, careless behavior, modification of equipment, misuse of tools

2. Answers may include any three of the following: cuts or abrasions, falls or spills, burns, shock, death.

INTRODUCTION TO CAREERS IN THE RESIDENTIAL ELECTRICIAN TRADE: Occupational Outlook

1.	F	6.	T
2.	T	7.	F
3.	T	8.	T
4.	T	9.	T
5.	F	10.	T

INTRODUCTION TO THE RESIDENTIAL ELECTRICIAN TRADE: Sources of Electrical Power

1. (Answers may be in any order)
   a. Hydro-electric plants
   b. Gas-fired plants
   c. Coal-fired plants
   d. Atomic generating plants

2. (Answers may be in any order)
   a. Wind-powered
   b. Gasoline-powered
   c. Solar-powered

3. (Answers may be in any order)
   a. Publicly owned
   b. Privately owned
   c. Cooperatives

4. (Answers may be in any order)

   a. Transmission lines--electrical lines that extend from generating plants to sub-stations or distribution centers

   b. Distribution lines--begin at the sub-station or distribution center and extend to the user

   c. Service lines--run from the meter to the point of use

INTRODUCTION TO THE RESIDENTIAL ELECTRICIAN TRADE: Uses of Electrical Power

1. Answers may be in any order. Uses of electric service will be evaluated to the satisfaction of the instructor.

2-3. Evaluated to the satisfaction of the instructor

INTRODUCTION TO THE RESIDENTIAL ELECTRICIAN TRADE: What Tools Are Used by Electricians?

Evaluated to the satisfaction of the instructor

INTRODUCTION TO THE RESIDENTIAL ELECTRICIAN TRADE: What Materials Are Used by Electricians?

Evaluated to the satisfaction of the instructor

FUNDAMENTALS OF THE RESIDENTIAL ELECTRICIAN TRADE: Basic Electrical Circuits

1. 120 times

2. It is more efficient because of its continuous flow at the same value.

3. Direct current flows in a path continuously in the same direction, while alternating current changes direction at regular intervals.

4. Voltage

5. It can be moved over long distances by using transformers and has more widespread applications at a much lower cost.

FUNDAMENTALS OF THE RESIDENTIAL ELECTRICIAN TRADE: The Electron Theory and Ohm's Law

1. Insulator

2. Ammeter

3. Voltage

4. Watt

ANSWERS TO ASSIGNMENT SHEETS

PAINTING AND DECORATING

SAFETY: Painting Safety

1.	T	6.	T
2.	F	7.	T
3.	T	8.	F
4.	F	9.	T
5.	T	10.	T

INTRODUCTION TO CAREERS IN PAINTING AND DECORATING: Occupational Information

1.	T	6.	F
2.	F	7.	F
3.	T	8.	T
4.	T	9.	T
5.	T	10.	F

INTRODUCTION TO PAINTING AND DECORATING: Tools and Equipment

1.	M	6.	C	11.	N
2.	I	7.	J	12.	A
3.	E	8.	D	13.	K
4.	G	9.	O	14.	B
5.	L	10.	F	15.	H

INTRODUCTION TO PAINTING AND DECORATING: Learning About Materials

Evaluated to the satisfaction of the instructor.

FUNDAMENTALS OF PAINTING AND DECORATING: Basics of Color

1.	T	6.	T
2.	F	7.	F
3.	T	8.	T
4.	F	9.	F
5.	T	10.	F

FUNDAMENTALS OF PAINTING AND DECORATING: Understanding Painting and Cleanup Procedures

1.	T	6.	T	11.	F
2.	F	7.	F	12.	T
3.	T	8.	F	13.	T
4.	T	9.	F	14.	F
5.	F	10.	T	15.	T

1.	T	6.	F
2.	T	7.	T
3.	F	8.	F
4.	T	9.	T
5.	T	10.	T

ANSWERS TO ASSIGNMENT SHEETS

PLUMBING/PIPEFITTING

SAFETY: Personal Safety

1. To prevent injury or death from cave-ins
2. Tend to the injury and immediately report it to your supervisor
3. By wearing goggles
4. It should be cleaned.
5. Scraps can cause serious accidents.
6. Receive permission to operate the machine from your supervisor. Read the operating instructions manual or get operating instructions from your supervisor. Make sure that you are familiar with all controls, and check all appropriate safety appliances.
7. They cause tripping hazards and can cause injury.
8. To prevent possible damage to the machine or injury to the operator.

SAFETY: Safe Handling and Storage of Materials and Tools

1. T
2. T
3. F
4. T
5. F
6. T
7. T
8. T
9. F
10. T

INTRODUCTION TO CAREERS IN PLUMBING/PIPEFITTING: Occupational Information

1. F
2. T
3. T
4. T
5. F
6. T
7. T
8. F
9. T
10. F

BEING YOUR OWN BOSS: Owning A Plumbing Business

1. (1) sole ownership
   (2) partnership, or limited partnership
   (3) corporation
2. one in which one partner supplies the capital and the other operates the business
3. design and install plumbing systems in buildings being constructed
4. (1) roughing-in

4. (1) roughing-in
   (2) topping-out
   (3) setting fixtures

5. repair leaky faucets, repair water closets, clean out sewer lines, etc.

6. a builder's permit

7. state sales taxes, state unemployment taxes, federal unemployment taxes, city taxes, and county taxes

8. to guarantee that a job will be completed

9. (1) a lump-sum contract
   (2) a cost-plus contract

10. in the plumber's home

11. (1) Analyze the position.
    (2) Determine what abilities the employee must have to fill the job.
    (3) Study personal factors, such as age, education, and health of the applicant.
    (4) Write a complete job description.
    (5) Interview objectively.
    (6) Check all references.
    (7) Compile and review all information before making a final selection.

12. the company's rules and policies and safety rules

INTRODUCTION TO PLUMBING/PIPEFITTING: Plumbing/Pipefitting Tools

1. T
2. T
3. F
4. T
5. F
6. T
7. T
8. T
9. F
10. T

INTRODUCTION TO PLUMBING/PIPEFITTING: Materials Used in Plumbing/Pipefitting

*Evaluated to the satisfaction of the instructor.

INTRODUCTION TO PLUMBING/PIPEFITTING: Plumbing Fixtures

1. E
2. D
3. H
4. C
5. A
6. G
7. F
8. J
9. I
10. B

FUNDAMENTALS OF PLUMBING/PIPEFITTING: Plumbing Symbols

1. C
2. F
3. G
4. E
5. J
6. B
7. A
8. H
9. D
10. I

FUNDAMENTALS OF PLUMBING/PIPEFITTING: Laying Out and Installing Water Supply Systems

1. Most working plans include only the locations of the various fixtures.

2. The plans state that the plumbing must meet the local plumbing codes.

3. (1) It should be constructed of pipe and fittings that are compatible with the soil and structure served by it.
   (2) It should provide adequate quantities of water at each fixture.
   (3) It should maintain the quality of water supplied to it.
   (4) It should not freeze during winter months.

4. Plumbers are aware of the kinds of pipe that are suitable for the local area.

5. Most municipalities provide approximately 40 to 50 pounds per square inch to homes.

6. It reduces the volume and increases the flow velocity.

7. The longer the pipe, the greater the friction, which slows the flow of water.

8. 7.4 feet per second

9. Each fitting increases the amount of resistance.

10. to prevent the possibility of cross-connections

11. The requirements in different geographical locations are different.

12. installing subsurface pipe in its correct location before the cement foundation is poured

13. installing the pipe that will be hidden by the walls

14. the actual setting of fixtures in their proper location

15. The forms have been set. The backfill has been put in place and leveled.

FUNDAMENTALS OF PLUMBING/PIPEFITTING: Laying Out and Installing Drain, Waste, and Vent Systems

1. provide adequate drainage for each fixture, trap odorous and poisonous gases, vent the system, and prevent siphonage

2. (1) It must be laid at a uniform grade.
   (2) It must be laid in straight lines.

3. between 1/4 inch and 1/8 inch per foot
4. The water runs away from the solids, creating a stoppage.
5. Water does not flow, and a stoppage results.
6. less than the inside diameter of the pipe
7. gravel or concrete pads
8. The drain will have a tendency to siphon the water from the trap.
9. Pipe size determines the depth of the water flowing through it.
10. The correct depth is required for good scouring action.
11. (1) The vent equalizes the atmospheric pressure inside the drain pipe and on the surface area of the water being drained.
    (2) Venting prevents pressure buildup in the drain pipe.
12. Water will be siphoned from the fixture traps.
13. It will blow the water from the nearest trap and then siphon out that which falls back into the trap.

ANSWERS TO ASSIGNMENT SHEETS

COMMON ESSENTIAL ELEMENTS

LEADERSHIP: Leadership Terms and Definitions

1. motivation
2. communicate
3. optimistic
4. autocratic
5. leadership
6. dependable
7. maturity
8. initiative
9. strength of conviction
10. democracy

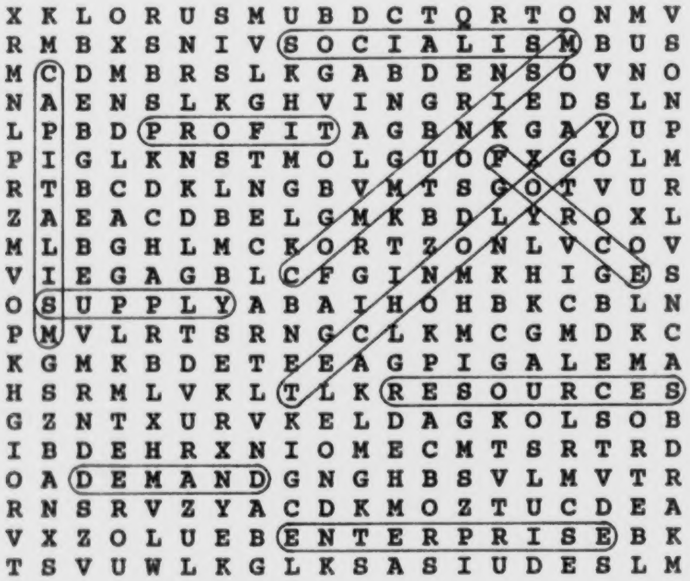
LEADERSHIP: Planning and Conducting a Meeting

Evaluated to the satisfaction of the instructor.

EMPLOYMENT: Employment Terms and Definitions

Evaluated to the satisfaction of the instructor.

ENTREPRENEURSHIP: Entrepreneurship Terms and Definitions



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X K L O R U S M U B D C T Q R T O N M V
R M B X S N I V S O C I A L I S M B U S
M C D M B R S L K G A B D E N S O V N O
N A E N S L K G H V I N G R I E D S L N
L P B D P R O F I T A G B N K G A Y U P
P I G L K N S T M O L G U O F X G O L M
R T B C D K L N G B V M T S G O T V U R
Z A E A C D B E L G M K B D L Y R O X L
M L B G H L M C K O R T Z O N L V C O V
V I E G A G B L C F G I N M K H I G E S
O S U P P L Y A B A I H O H B K C B L N
P M V L R T S R N G C L K M C G M D K C
K G M K B D E T E E A G P I G A L E M A
H S R M L V K L T L K R E S O U R C E S
G Z N T X U R V K E L D A G K O L S O B
I B D E H R X N I O M E C M T S R T R D
O A D E M A N D G N G H B S V L M V T R
R N S R V Z Y A C D K M O Z T U C D E A
V X Z O L U E B E N T E R P R I S E B K
T S V U W L K G L K S A S I U D E S L M
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ENTREPRENEURSHIP: Am I an Entrepreneur?

Evaluated to the satisfaction of the instructor.

ENTREPRENEURSHIP: Starting Your Own Business

Evaluated to the satisfaction of the instructor.

GENERAL SHOP SAFETY: Personal and Group Safety

1. accidents
2. attitude
3. attitudes, personal
4. accidents
5. Occupational Safety and Health Act
6. alert
7. avoided, accident-prone
8. injury
9. conditions, practices, others
10. actions, you, classmates

GENERAL SHOP SAFETY: Work Safety in the Shop

1. F
2. T
3. T
4. F
5. F
6. F
7. T
8. F
9. T
10. T
11. F
12. T
13. T
14. F
15. F

GENERAL SHOP SAFETY: Fire Safety

Evaluated to the satisfaction of the instructor.

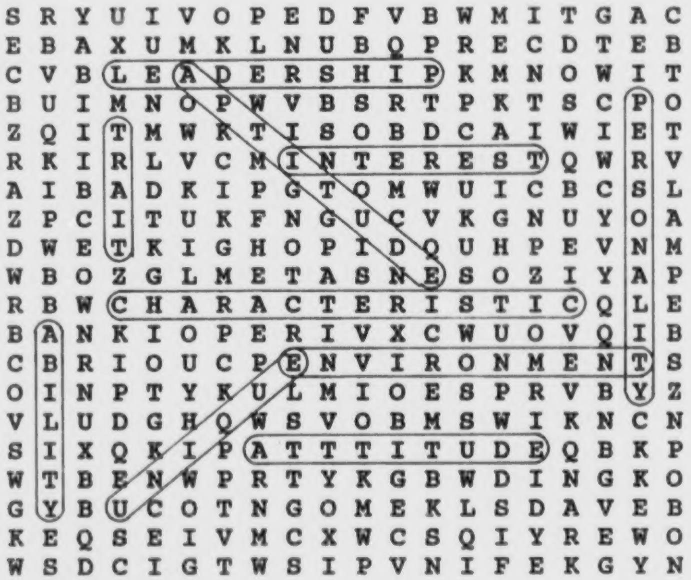
GENERAL SHOP SAFETY: Safety with Hand and Power Tools

1. Hand
2. Power
3. attention
4. best
5. dry
6. off

7. off
8. three-wire
9. Do not
10. off

HUMAN RELATIONS AND PERSONALITY DEVELOPMENT: Terms and Definitions for Human Relations and Personality Development

1. interest
2. trait
3. leadership
4. aptitude
5. personality
6. environment
7. attitude
8. ability
9. unique
10. characteristic



S	R	Y	U	I	V	O	P	E	D	F	V	B	W	M	I	T	G	A	C
E	B	A	X	U	M	K	L	N	U	B	Q	P	R	E	C	D	T	E	B
C	V	B	L	E	A	D	E	R	S	H	I	P	K	M	N	O	W	I	T
B	U	I	M	N	O	P	W	V	B	S	R	T	P	K	T	S	C	P	O
Z	Q	I	T	M	W	K	T	I	S	O	B	D	C	A	I	W	I	E	T
R	K	I	R	L	V	C	M	I	N	T	E	R	E	S	T	Q	W	R	V
A	I	B	A	D	K	I	P	G	T	O	M	W	U	I	C	B	C	S	L
Z	P	C	I	T	U	K	F	N	G	U	C	V	K	G	N	U	Y	O	A
D	W	E	T	K	I	G	H	O	P	I	D	Q	U	H	P	E	V	N	M
W	B	O	Z	G	L	M	E	T	A	S	N	E	S	O	Z	I	Y	A	P
R	B	W	C	H	A	R	A	C	T	E	R	I	S	T	I	C	Q	L	E
B	A	N	K	I	O	P	E	R	I	V	X	C	W	U	O	V	Q	I	B
C	B	R	I	O	U	C	P	E	N	V	I	R	O	N	M	E	N	T	S
O	I	N	P	T	Y	K	U	L	M	I	O	E	S	P	R	V	B	Y	Z
V	L	U	D	G	H	Q	W	S	V	O	B	M	S	W	I	K	N	C	N
S	I	X	Q	K	I	P	A	T	T	T	I	T	U	D	E	Q	B	K	P
W	T	B	E	N	W	P	R	T	Y	K	G	B	W	D	I	N	G	K	O
G	Y	B	U	C	O	T	N	G	O	M	E	K	L	S	D	A	V	E	B
K	E	Q	S	E	I	V	M	C	X	W	C	S	Q	I	Y	R	E	W	O
W	S	D	C	I	G	T	W	S	I	P	V	N	I	F	E	K	G	Y	N

HUMAN RELATIONS AND PERSONALITY DEVELOPMENT: Self-Concept Checklist

Evaluated to the satisfaction of the instructor.

PERSONAL AND BUSINESS MANAGEMENT: Terms and Definitions for Personal and Business Management

Across

1. collateral
5. certified
6. needs
7. endorsement
9. gross
10. inflation
14. serial
15. counterfeit
17. reconciling
18. bank
19. signature

Down

1. canceled
2. loan
3. voiding
4. denomination
8. deposit
11. interest
12. service
13. overdraft
16. wants

PERSONAL AND BUSINESS MANAGEMENT: Budgets

Evaluated to the satisfaction of the instructor.

APPENDIX D

ANSWERS TO PRE/POSTTESTS

ANSWERS TO PRE/POSTTEST

AIR CONDITIONING AND REFRIGERATION

1. a. Lift with your legs bent so you lift with your legs and not your back.
   b. Replace it.
   c. Because extra force is needed to make dull tools cut and may cause an accident.
   d. Near the end of the handle.
   e. Disconnect the machine from the power circuit.
   f. Double insulated
   g. An energized circuit
   h. A nonconductive object
   i. To give a positive image of your company and to avoid embarrassment
   j. Do not argue with them. Just answer direct questions in an honest, friendly way.
   k. Our attitudes.
   l. Condensing units, evaporators, motors, and compressors
   m. 144 hours
   n. It is more efficient because of its continuous flow at the same value.

2. a. taper socket reamers
   b. hand dies
   c. twist drill
   d. chucking reamer
   e. hand taps
   f. file

3. a. electronic leak detector
   b. test gauge
   c. halide leak detector

4. a. common types of rivets
   b. wire solder
   c. heat sink
   d. self-tapping screws
   e. common types of nails
   f. desoldering tool

5. a. sensible, latent, and total
   b. a thermometer
   c. the amount of moisture in the air
   d. to add moisture to the air
   e. rotary, centrifugal, and reciprocating
   f. an armature
   g. centrifugal type
   h. a relay
   i. in a counterclockwise direction

ANSWERS TO PRE/POSTTEST

BRICKLAYING/STONE MASONRY

1. a. acid
   b. a NIOSH-approved respirator
   c. hard hats and hard-toed shoes
   d. when materials being handled are sharp or likely to cause damage if dropped.
   e. only authorized persons
   f. while materials are being handled
   g. at a given signal
   h. in glass containers in low locations, such as bottom shelves
   i. in a sheath or tool belt
   j. goggles
   k. walls, walks, patios, partitions, fireplaces, and other structures
   l. limestone, granite, and marble
   m. at least 17 years old
   n. sole ownership
   o. scheduling problems
   p. late material deliveries
   q. the person's experience, attitude, and abilities
   r. This gives both you and the applicant a chance to ask questions about the job.
   s. an orientation period
   t. the job responsibilities

2. a. mortar box
   b. convex jointer
   c. mortar hoe
   d. brick chisel
   e. brick hammer
   f. mortarboard

3. a. hollow tile
   b. concrete blocks
   c. brick

4. a. T
   b. T
   c. T

ANSWERS TO PRE/POSTTEST

CARPENTRY

1. a. because paint might conceal breaks, cracks, or other defects
   b. toward the ladder
   c. You may loose your balance easily.
   d. never more than arm's length
   e. at a distance not to exceed one-quarter of the ladder's full length
   f. the types of material required, the dimensions of the structure, and the location of structural parts
   g. at least 17
   h. when a person other than the builder owns the land on which the sturcture is to be built
   i. to see that there are no mortgages, liens, delinquent taxes, or other conditions that might threaten legal ownership
   j. building for a particular person, persons, or firm
   k. because every detail must be covered to the customer's satisfaction before construction begins
   l. zoning laws
   m. from the Internal Revenue Service

2. a. hand drill
   b. circular saw
   c. brace
   d. ripping bar
   e. saber saw
   f. flat file

3. a. subfloor
   b. backfill
   c. overhang
   d. foundation
   e. bearing wall
   f. hip roof

ANSWERS TO PRE/POSTTEST

RESIDENTIAL ELECTRICIAN TRADE

1. a. qualified person
   b. live wire
   c. electrical shock
   d. modification
   e. short circuit

2. a. T
   b. F
   c. T

3. Any three of the following

   Hydro-electric plants
   Gas-fired plants
   Coal-fired plants
   Atomic generating plants

4. Evaluated to the satisfaction of the instructor.

5. a. wire stripper
   b. long nose plier
   c. power drill
   d. fuse
   e. utility knife

6. a. metallic armored cable (BX)
   b. circuit breaker
   c. wire nut
   d. pipe cutter
   e. single pole switch

7. a. 120 times
   b. Direct current flows in a path continuously in the same direction, while alternating current changes direction at regular intervals.
   c. Voltage

ANSWERS TO PRE/POSTTEST

PAINTING AND DECORATING

1. a. T
   b. F
   c. T
   d. T
   e. T
   f. T
   g. F
   h. T
   i. T
   j. T

2. a. joint trowel
   b. strippling paintbrush
   c. corner roller
   d. paint roller
   e. roller pan
   f. paste brush

3. a. T
   b. F
   c. T
   d. F
   e. T
   f. F
   g. T
   h. T
   i. F
   j. F
   k. F
   l. T
   m. T
   n. T
   o. T

ANSWERS TO PRE/POSTTEST

PLUMBING/PIPEFITTING

1. a. To prevent injury or death from cave-ins
   b. By wearing goggles
   c. To prevent possible damage to the machine or injury to the operator.

2. a. F
   b. T
   c. T
   d. F
   e. T
   f. T

3. a. One in which one partner supplies the capital and the other operates the business.
   b. a builder's permit
   c. to guarantee that a job will be completed

4. a. flaring tool
   b. pipe reamer
   c. pipe threader
   d. crimping tool
   e. basin wrench
   f. adjustable wrench

5. a. dish spray
   b. double handle bathtub faucet
   c. water closet
   d. corner bathtub
   e. ledge back lavatory
   f. single compartment kitchen sink

6. a. hot water
   b. gas
   c. recessed tub
   d. cesspool
   e. wall lavatory
   f. kitchen sink

7. a. The plans state that the plumbing must meet the local plumbing code.
   b. It reduces the volume and increases flow velocity.
   c. The requirements in different geographical locations are different.
   d. between 1/4 inch and 1.8 inch per foot
   e. The water runs away from the solids, creating a stoppage.
   f. Water will be siphoned from the fixture traps.

APPENDIX E

PRE/POSTTESTS

PRE/POSTTEST

AIR CONDITIONING AND REFRIGERATION

NAME: ______________________________ DATE: ____________

1. Read and answer each of the following questions in the space provided.

   a. What is the correct lifting and carrying procedure for heavy objects?

   b. What should be done if there is any doubt about the safeness of a ladder?

   c. Why should cutting tools be kept sharp?

   d. Where should a hammer be held?

   e. What should be done if it is necessary to change parts or perform maintenance on a power tool?

   f. How should a power cord be marked if it is a two cord wire?

   g. What is an electrical circuit called when it is connected with the power on?

   h. What should be used to break a shock victim loose from an electrical contact?

i. Why should you be concerned with company policy?

j. How should you deal with an irate customer?

k. What usually controls our behavior?

l. What units are repaired and installed by air-conditioning and refrigeration mechanics?

m. How many hours of classroom instruction are received by apprentices?

n. What is the advantage of using direct current instead of alternating current?

2. Identify each of the air-conditioning and refrigeration hand tools shown by writing the correct name in the blank.

twist drill
file
hand dies
hand taps
taper socket reamers
chucking reamer

a.____________

b.____________

c.____________

d.____________

e.____________

f.____________

3. Identify each of the air-conditioning and refrigeration tools shown by writing the correct name in the blank.

test gauge
electronic leak detector
halide leak detector

a.____________ b.____________ c.____________

4. Identify each of the air-conditioning and refrigeration materials shown by writing the correct name in the blank.

wire solder	heat sink
common type of rivets	common types of nails
self-tapping screws	desoldering tool

a.____________ b.____________ c.____________

d.____________ e.____________ f.____________

5. Read and answer each of the following questions in the space provided.

a. What are the three basic types of heat?

b. What is used to measure sensible heat?

c. What is humidity?

d. What is the function of a humidifier?

e. What are the three types of refrigerant compressors?

f. What is another name for a rotor?

g. What type of switch is mounted on a squirrel-cage rotor?

h. What is used to switch high-voltage equipment on and off using a safer low-voltage circuit?

i. In what direction does the blower motor turn the fan blade?

PRE/POSTTEST

BRICKLAYING/STONE MASONRY

NAME:______________________________________ DATE:____________

1. Read and answer each of the following questions in the space provided.

   a. What cleaning agent may cause a health threat to masonry workers?

   b. What should be worn when working around dust or fumes?

   c. What should be worn for protection from tools or materials that might fall from walls or scaffolds?

   d. When should foot and leg guards be worn?

   e. Who should be permitted in storage areas?

   f. When do a majority of industrial accidents happen?

   g. When two or more people are working together, when must lifting and lowering be done?

   h. Where should acids be stored?

   i. How should sharp-pointed tools be carried?

j. What should be worn when using pounding tools?

k. What do bricklayers construct?

l. What natural stones are used by stonemasons?

m. How old must an applicant be for acceptance in the apprenticeship program?

n. What form of business ownership is used by most masonry owners?

o. What does an understaffed operation cause?

p. What may disrupt an entire building program?

q. What must hiring be based on?

r. Why is an interview important?

s. What should all employees have when they begin a new job?

t. What determines the length of the training period?

2. Identify each of the bricklaying/stone masonry tools shown by writing the correct name in the blank.

mortar hoe	brick chisel
mortar hod	mortarboard
brick hammer	convex jointer

a.___________ b.___________ c.___________

d.___________ e.___________ f.___________

3. Identify each of the bricklaying/stone masonry tools shown by writing the correct name in the blank.

hollow tile
brick
concrete blocks

a.___________ b.___________ c.___________

4. After reading each statement below, indicate if the statement is true or false by circling T or F.

T F a. The 12-inch rule is divided into twelve equal parts.

T F b. You must know how to work fractions in order to use a rule correctly.

T F c. Math skills are necessary when mixing materials such as cement, lime, mortar, and concrete.

PRE/POSTTEST

CARPENTRY

NAME:____ DATE:______________

1. Read and answer each of the following questions in the space provided.

   a. Why should ladders be finished with only transparent materials?

   b. In what direction should a person face when climbing up or down a ladder?

   c. Why should you avoid standing on the top of a stepladder?

   d. What is the maximum distance that a person should reach when working on a ladder?

   e. How far out should the foot of a ladder be placed, compared to the ladder's extended height?

   f. What information can a carpenter gain from reading blueprints, sketches, and building plans?

   g. How old must a person be to enroll in a carpentry apprenticeship program?

   h. When should a mechanic's lien be drawn up?

   i. Why should a lawyer inspect the title to the property?

j. What is a custom building?

k. Why is the planning stage for a custom builder difficult?

l. What laws must be taken into account when a building permit is obtained?

m. Where does a building contractor obtain an employer's identification number?

2. Identify each of the carpentry tools shown by writing the correct name in the blank.

brace	flat file
hand drill	circular saw
saber saw	ripping bar

a.____________ b.____________ c.____________

d.____________ e.____________ f.____________

3. Match the following terms to the correct definitions by placing the correct word in the blank.

backfill
foundation
overhang
bearing wall
hip roof
subfloor

____________ a. boards or plywood laid on joists over which a finish floor is to be laid

____________ b. putting back dirt into a trench around and against a basement foundation

____________ c. the distance that the rafters extend over the edge of the plate

____________ d. the supporting part of a structure below the first-floor construction or below ground level; includes footings

____________ e. a wall that supports any vertical load in addition to its own weight

____________ f. a roof that rises by inclined planes (slopes) from all four sides of a building

PRE/POSTTEST

RESIDENTIAL ELECTRICIAN TRADE

NAME:____ DATE:______________

1. Match the following terms to the correct definitions by placing the correct word in the blank.

modification
qualified person
live wire
electrical shock
short circuit

____________ a. A person who knows the work area involved.

____________ b. A current-carrying wire.

____________ c. An electric current passing through a person's body.

____________ d. A slight change in form or use.

____________ e. A side current caused by bad wiring so that the electric current is turned aside from the main circuit.

2. Read each of the following statements. If the statement is true, circle the T. If the statement is false, circle the F.

T F a. Electricians who work in the area of repair must first locate the source of the problem.

T F b. All electricians earn the same wage regardless of their training, skill, or experience.

T F c. A four-year apprenticeship program is recommended for electricians.

3. List three types of electrical power plants.

a.

b.

c.

4. List three ways in which you personally use electricity everyday.

a.

b.

c.

5. Identify each of the tools shown below by placing the correct name in the blank.

power drill
wire stripper
long nose plier
pipe cutter
utility knife

a.____________ b.____________ c.____________

d.____________ e.____________

6. Identify each of the materials shown below by writing the correct name in the blank.

metallic armored cable (BX)
fuse
circuit breaker
single pole switch
wire nut

a.____________ b.____________ c.____________

d.____________ e.____________

7. Read and answer each of the following questions in the space provided.

a. How many times does alternating current change in one second?

b. How is a direct current different from alternating current?

c. What is the force that causes the current to move thorugh the conductive wires?

PRE/POSTTEST

PAINTING AND DECORATING

NAME:____ DATE:____________

1. Read each of the following statements carefully. Circle T or F to indicate if the statement is true or false.

T F a. There are specific safety precautions which must be used when working with solvents and paints.

T F b. Solvents should be placed in large, open containers when in use.

T F c. You should never use or store paints near heat or open flame.

T F d. Solvents may cause skin irritation.

T F e. Solvent vapors are heavier than air and can travel long distances close to the floor.

T F f. Room ventilation is important when working with solvents or paints.

T F g. Painters work only in the area of new construction.

T F h. Many painters and decorators work for contractors.

T F i. Knowledge in the use of hand and power tools is important for painters and decorators.

T F j. Individuals interested in painting and decorating should take advantage of high school courses in mathematics, art, business, and vocational courses.

2. Identify each of the painting and decorating tools shown by writing the correct name in the blank.

paint roller	roller pan
joint trowel	paste brush
corner roller	strippling paintbrush

a.__________ b.__________ c.__________

d.__________ e.__________ f.__________

3. Read and answer each of the following statements. If the statement is true, circle the T; if false, circle the F.

T F a. A knowledge of the psychological effects of color is important for painters and decorators.

T F b. White is thought to be depressive.

T F c. The size of the room should be considered when selecting color.

T F d. Individual's preferences for colors remain the same throughout their lifetime.

T F e. Blue and green are thought to be both sedative and cool.

T F f. There is no need to prime new wood.

T F g. Baseboards should be painted last.

T F h. Be sure to follow directions on the can when mixing paint.

T F i. Paint always covers the surface on the first coat.

T F j. You may apply the second coat of paint before the first coat of paint has dried.

T F k. A smooth, solid-surfaced tape is used in drywall finishing.

T F l. Nail heads should be covered with joint compound.

T F m. Special drywall tools are designed to assist in finishing drywall.

T F n. Taping and bedding provide for better insulation by sealing the joints.

T F o. Perforated paper tape is used in drywall finishing.

PRE/POSTTEST

PLUMBING/PIPEFITTING

NAME:____ DATE:______________

1. Read and answer each of the following questions in the space provided.

   a. Why should you not work in a deep ditch or trench until it has been properly shored?

   b. How should you protect your eyes during a grinding or chipping operation?

   c. Why should any machine be stopped before any adjustment or measurements are made on the stock or machine?

2. Read each of the following statements carefully. Indicate if the statement is true or false by circling the T or F.

T F a. Flammable liquids should be kept in open containers.

T F b. Your back should be kept straight when lifting a load.

T F c. It is best to use a low-hazard solvent as a cleaning agent.

T F d. Plumbers and pipefitters install only new pipe systems.

T F e. Apprenticeship is the best way for plumbers or pipefitters to learn all aspects of these trades.

T F f. Plumbers install water, gas, and waste disposal systems in homes, schools, factories, and other buildings.

3. Read and answer each of the following questions in the space provided.

   a. What is a limited partnership?

b. What is the license called that must be obtained before installing new plumbing or adding to an existing plumbing system?

c. What is the purpose of a performance bond?

4. Identify each of the plumbing/pipefitting tools shown by writing the correct name in the blank.

pipe reamer
basin wrench
adjustable wrench
flaring tool
pipe threader
crimping tool

a.___________ b.___________ c.___________

d.___________ e.___________ f.___________

5. Identify each of the plumbing/pipefitting fixtures shown by writing the correct name in the blank.

- water closet
- corner bathtub
- ledge back lavatory
- dish spray
- single compartment kitchen sink
- double handle bathtub faucet

a.__________ b.__________ c.__________

d.__________ e.__________ f.__________

6. Identify each of the following symbols by writing the correct name in the blank.

- recessed tub
- gas
- cesspool
- wall lavatory
- hot water
- kitchen sink

a.__________ b.__________ c.__________

d.__________ e.__________ f.__________

7. Read and answer each of the following questions in the space provided.

   a. Why is it important that the plumber know the local plumbing code?

   b. How does the use of pipe that is too small affect the water supply?

   c. Why can there be no uniform code across the United States?

d. How much fall must sewer pipe have?

e. What happens if a sewer has too much fall?

f. What happens if the atmospheric pressure is not equalized?

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulations by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs or activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups

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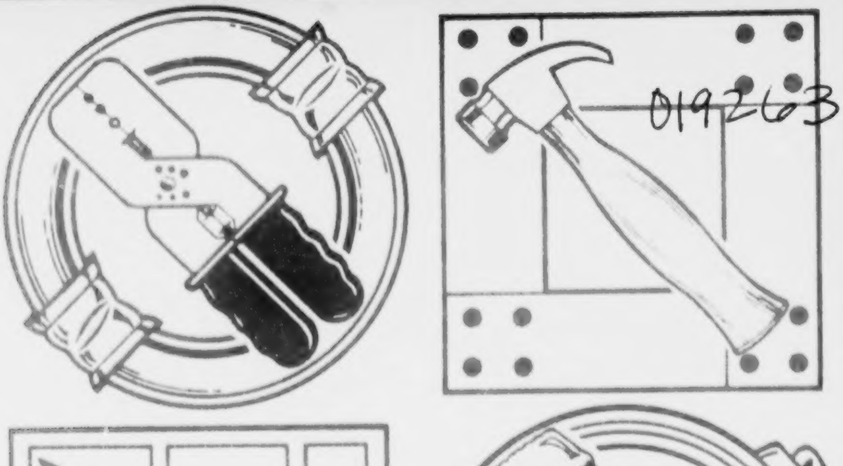
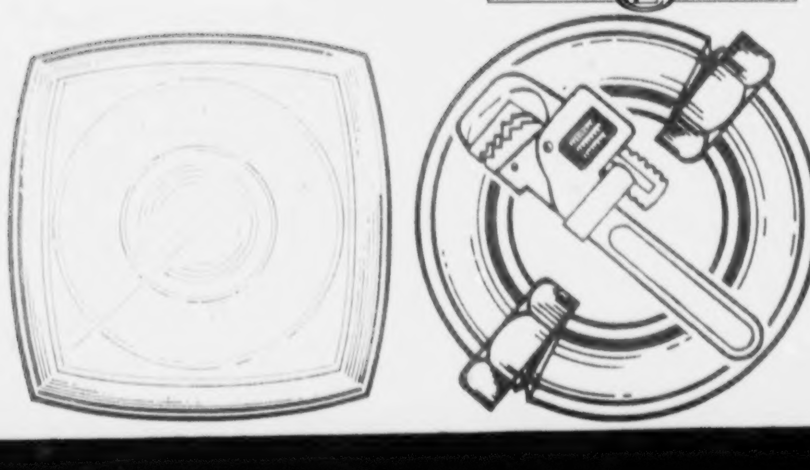


STUDENT MATERIALS MANUAL

Introduction to Construction Careers Cluster



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TI-310-SM

INTRODUCTION TO CONSTRUCTION CAREERS CLUSTER

STUDENT MATERIALS MANUAL

DEVELOPED
BY
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OCCUPATIONAL CURRICULUM LABORATORY
TRADE AND INDUSTRIAL EDUCATION
EAST TEXAS STATE UNIVERSITY

IN COOPERATION WITH

TEXAS EDUCATION AGENCY
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SECTION I

AIR CONDITIONING AND REFRIGERATION

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Safety

TOPIC: General Job Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. describe the procedure to follow for proper ladder and scaffolding safety;
2. explain how relations with other employees can affect his/her own safety;
3. discuss the importance of safe attitudes on the job;
4. list the steps to take when lifting heavy weights; and
5. describe the kind of clothing that should be worn on the job.

When you report for work in the field of air conditioning and refrigeration, you may work in homes, business offices, or other buildings. Sometimes, you will work in the shop on special repair jobs. The general job-safety precautions cover a wide area because of the variation in job circumstances. An air-conditioning and refrigeration mechanic often may be required to install or maintain equipment that is located on the roofs of buildings several stories high. Air-conditioning equipment for new buildings must be installed while the building is under construction. When the working level rises above the ground, temporary elevated platforms called **SCAFFOLDS** must be used. These platforms support the workers, tools, and materials, while the job is being performed.

Ladder and Scaffold Safety

All ladders should be inspected often. In fact, before you climb any ladder, you should give it a good visual inspection. The protective finish coat used on a ladder should be a clear transparent material, such as linseed oil or shellac. This will allow you to detect any breaks, cracks or other hazardous defects. If there is the slightest doubt about the safeness of a ladder, it should be removed from the job at once and replaced with a more reliable one.

It is advisable to have separate ladders for going up and down. The top of a ladder should not be placed against a window sash unless it rests on a 2-by-4-inch board that has been nailed across the opening. A ladder must also have secure underfooting. A distance of no more than one-fourth of the extended height of the ladder should exist from the bottom of the ladder to the building on which it is leaning. Always face the ladder when ascending or descending, and have both hands free to climb.

Never try to carry tools when climbing a ladder. Tools and materials should be hoisted up and down mechanically. Never reach more than one arm's length when working from a ladder or scaffold. Materials, like paint, that might spill can be hung by hooks or handles from the rungs of a ladder.

Working on a scaffold can be dangerous if safety precautions are not observed. For example, an accumulation of tools, equipment, materials, and trash on a scaffold should be avoided. Someone could easily trip over these things and fall. Only materials needed for the job at hand should be stored on a scaffold. Safe containers for tools should be provided, so that tools will not be knocked off, when not in immediate use. It is extremely important to maintain scaffolds so that they are always safe to use. All scaffold equipment--including supporting lines, tackles, and structural members--should be inspected every day, before use. A protective hard hat should be worn when it is necessary to work under the scaffold.

Never work on scaffolds during high winds or in other unfavorable weather conditions. When there are signs of a storm coming, discontinue work at once. Only standard scaffolds with proper bracing and reinforcing should be used. Makeshift substitutes should never be used.

Safe Employee Behavior

Whenever two or more employees must work together, job-safety factors must be considered. If an employee is careless, this carelessness can result in an accident. The victim of the accident may be someone other than the careless employee. There must be complete cooperation between all employees on a job. Safety is everybody's business. Knowing and following safety rules is the responsibility of every employee. If co-workers start to clown around or act in an unsafe manner on the job, ask them to stop. If they do not stop their unsafe activity, you may want to mention their behavior to the supervisor. The Occupational Safety and Health Act (OSHA) employs government safety officials to inspect safety conditions on trade and industrial job sites and shop areas. The employer may be fined thousands of dollars for safety violations discovered on the job. It is assumed that the employer will instruct the employees on safety and, especially, cooperative safety attitudes.

Safety Attitudes

A proper attitude toward safety in general is the place to begin when it comes to safety attitudes on the job. Every trade and industrial job has many different aspects. The way you behave in each situation reveals a specific job attitude. You learned earlier about OSHA and how important it is to the employer that you display constructive attitudes about safety on the job at all times. However, even when the employer does an excellent job of providing safe conditions and instructing the employees in job safety, it will be to no avail for an employee who does not have the proper attitude toward safety. If not practiced, all of the safety instruction in the world will do no good. A careless attitude toward safety can sometimes be changed by a new experience. When employees see the employer dismiss a fellow employee because of unsafe behavior on the job, it can be a strong motivation for them to improve their own attitudes toward safety.

If you have a constructive work attitude, you will want to perform tasks correctly on the job. This is basic to a positive attitude toward safety. For example, it makes sense to keep cutting and drilling

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tools sharp, because cutting and drilling can be done more easily and quickly than if the tools are not kept sharp. When a cutting tool is dull, you must exert extra force to get the job done. This may cause you to slip and cut yourself. If you try to drill a hole using a dull drill bit, the results may be the same. If tools are not cared for properly, and correct operating procedures for using hand and power tools are not followed, the results may not only be inefficiency, but also an accident.

Lifting and Carrying Procedures

At times, you will need to lift heavy objects on the job. When lifting, bend your legs slightly so that the weight of the load is lifted with your legs and not your back. If the load is especially heavy, have another person help you. You should always wear proper protective devices--for example, a face shield--when moving dangerous materials or equipment that have the potential to explode or to spill in a harmful way. It is always important to understand the characteristics of materials or equipment you must move from one place to another. Always read and follow the manufacturer's recommendations.

Clothing

The type of clothing you wear on the job is important to safety. You should never wear loose-fitting clothes or jewelry that might catch on anything. Never wear shoes that could slip in the repair shop, or on a ladder. When you work around any moving machinery, you should not wear a tie, gloves, or any article of clothing or jewelry that might get caught in the machinery and pull you into it. Long hair could get caught in moving machinery. The price of getting a haircut or choosing a different hairstyle is cheap when you consider that the alternative might be a severe injury.

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Safety

TOPIC: General Job Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this assignment sheet, the student will be able to:

1. describe the procedures to follow for proper ladder and scaffolding safety;
2. explain how relations with other employees can affect his/her own safety;
3. discuss the importance of safe attitudes on the job;
4. list the steps to take when lifting heavy weights; and
5. describe the kind of clothing that should be worn on the job.

REFERENCE: Student Information Sheet/General Job Safety

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What should you do before you climb a ladder?

2. What is the proper procedure for going up and down a ladder?

3. What is the correct lifting and carrying procedure for heavy objects?

4. What should be done if there is any doubt about the safeness of a ladder?

5. What may be done by OSHA officials if safety rules are violated on the job?

6. How far from the bottom of the building should a ladder be placed?

7. What rules should be followed for proper scaffolding safety?

8. Why should cutting tools be kept sharp?

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JOB SHEET

AIR CONDITIONING AND REFRIGERATION

NAME:______________________________ **DATE:**________________________

UNIT: Safety

NAME OF JOB: Setting Up a Ladder

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to set up a leaning ladder correctly.

TOOLS AND EQUIPMENT: Leaning ladder

MATERIALS: No materials are required

GENERAL INSTRUCTIONS: Following safety procedures given in class, set the ladder up against the wall of your classroom.

PROCEDURES AND/OR TASKS:

1. Check the ladder for cracks or other defects.
2. Place the ladder against the wall of your classroom.
3. Make sure the footing is secure.
4. Check to see that the base of the ladder extends out from the wall no more than one-fourth the height of the ladder.
5. Have your instructor check the position of the ladder.
6. Replace the ladder.

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Safety

TOPIC: Hand Tool and Power Tool Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. tell how common hand tools can be dangerous if not properly maintained;
2. discuss the importance of keeping all cutting tools sharp;
3. explain how the proper maintenance of power tools can prevent accidents;
4. explain how operating power tools correctly will result in fewer accidents; and
5. discuss proper procedures for storing sharp tools.

There are right and wrong ways to use all hand tools no matter how simple their construction. One of the most basic of hand tools is the hammer. For air-conditioning and refrigeration work, the ball-peen hammer (figure 1) is the tool most often used. Any hammer should be held near the end of the handle. The object you are striking should always be struck with the full face of the hammer. When you are striking a chisel, the head of the chisel should always be struck flat, along the full surface of its head.

Proper Care of Hand Tools

If you fail to use and maintain hand tools properly, the result may be a painful injury to yourself or another worker. For example, when hammers and chisels are allowed to develop mushroomed heads, as shown in figure 2, a piece of the thin metal edge from the head can easily fly off and cause injuries. Of course, goggles should be worn for any job where chips might flyoff. Nearby workers should also be considered. Use a grindstone to grind off any mushroomed edges on hammers and chisels. The hazard will be removed, and the tools will also last longer.

Cutting Tools

Any cutting tool must always be used with great care. Whether it is a knife, chisel, drill bit, or another implement used to cut into the surface of hard materials, a few common safety rules apply. Always inspect a tool carefully before using it, and cut away from your body so the cutting edge will be away from you if it should slip. If it is dull, it should be sharpened. You are more likely to cut yourself with a dull cutting tool than with a sharp one because, often, more force must be used to make the cut. As a result, you may lose control of the tool and cut yourself, or break the tool.

Maintenance of Power Tools

Make a careful visual inspection of any power tool before you use it. Also, be sure you are in a safe area for using a power tool. The area should be free of explosive or combustible liquids and gases. You have already learned about the importance of having positive attitudes toward safety and inspecting equipment carefully before using it, but this cannot be stressed too much. A frayed electrical power-tool cord will never be discovered by a mechanic too hurried to examine it. All power tools must be properly connected to the electric circuit. Modern electrical codes require that three-wire cords be used to provide safe grounding.

Another important safety rule is to keep power tools in good condition, dry and protected from dampness and dirt. Always check for loose bolts and other parts of power tools that need to be tight. The proper maintenance of all parts of power tools is of primary importance.

Power-Tool Operations Procedures

For every power tool there is a correct operating procedure to follow when using it on the job. If guards are provided on the tools, they should not be removed. No power tool--for example, a grinder or metal-cutting saw should be used without wearing protective goggles or a face shield. The same rule applies to using the drill press and the portable electric hand drill. A few drops of oil should be added to the cutting tools while they are cutting or drilling in metal, to remove some of the heat and make cutting easier. Never force a tool. Never use any electric power tool when you are standing on wet ground. Do not work on a material unless it is fastened securely or clamped so it will not slip or twist. If it is necessary to change parts or perform any kind of maintenance on a power tool, disconnect the machine from the power circuit. When you must use portable power tools, be especially careful that the electric cord does not become tangled in any way. If an electric power cord is a two-wire cord instead of a three-wire cord, it should be marked **DOUBLE INSULATED**. Double-insulated tools have two separate insulations. For example, the switch would have standard insulation, and it would also be mounted on another insulating assembly. The same would be true for all other current-carrying parts of the power tool. Both insulations are protected against mechanical damage and arranged so that even if one of the insulations was damaged the user would not receive a shock.

Tool Storage

If tools are not stored properly and in proper locations, they may not be in safe condition for use, even though they have been used correctly and are well maintained. When tools are not going to be used for a while, they should be placed in a dry place in such a way that they cannot fall or be knocked out of their place. Most shops have a tool room or a specified area where a designated employee checks the condition of tools at regular intervals. The silhouette of each tool is sometimes painted on the wall or shelf where the tool is stored, which makes it easier to account for the tools and spot a missing tool.

Special clamps and vices should also be stored with the unused tools. These are valuable tools for metalworking trades. They must often be used to hold pieces of metal together while they are being soldered, brazed, or welded. The type of clamp shown in figure 3 is called a C-clamp because it is shaped like the letter C. It is a commonly used clamp in the air-conditioning and refrigeration trade. Another frequently used holding tool is the pipe vise shown in figure 4.

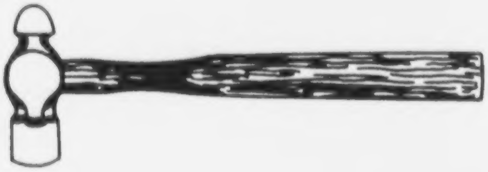

Figure 1. Ball-peen hammer

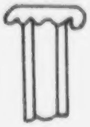

Figure 2. Mushroom head on chisel

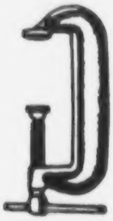

Figure 3. C-clamp

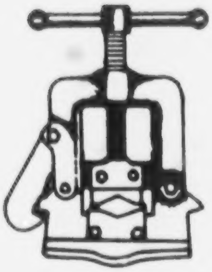

Figure 4. Pipe vise

AIR CONDITIONING AND REFRIGERATION

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ **DATE**__________

UNIT: Safety

TOPIC: Hand Tool and Power Tool Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this assignment sheet, the student will be able to:

1. tell how common hand tools can be dangerous if not properly maintained;
2. discuss the importance of keeping all cutting tools sharp;
3. explain how proper maintenance of power tools can prevent accidents;
4. explain how operating power tools correctly will result in accidents; and
5. discuss proper procedures for storing shop tools.

REFERENCE: Student Information Sheet/Hand Tool and Power Tool Safety

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What type of hammer is most frequently used in air-conditioning and refrigeration work?

2. Where should the hammer be held?

3. What should be done to mushroomed edges of hammers and chisels?

4. Why are you more likely to cut yourself with a dull cutting tool?

5. What should you do before using any power tool?

6. What should be worn when using a grinder or metal-cutting tool?

7. What should be done if it is necessary to change parts or perform maintenance on a power tool?

8. How should a power cord be marked if it is a two-wire cord?

9. What should be done with tools that will not be used for a while?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Safety

TOPIC: Electrical Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. explain how to work on energized electrical equipment without receiving a shock; and
2. tell what to do when a shock victim is discovered near electrical equipment.

Electrical troubleshooting is an important part of air-conditioning and refrigeration service work. Sometimes, when working with air-conditioning and refrigeration, you will need to operate equipment with the electrical power on. The cover or side panel of the unit being worked on is removed so the moving parts and electrical circuits can be observed in operation. At the same time, the electrical circuits can be checked for electrical problems.

Troubleshooting the electrical system of an air conditioner inside a metal cabinet can be quite dangerous, unless you have a thorough knowledge of electrical safety rules. This is particularly true when you must check energized circuits (circuits with electrical power on). When you must reach inside the cabinet with the power on, use only one hand, keeping the other one behind you or in your pocket. This way, if you should receive a shock, the current will not pass through your heart as it will if both hands touch the energized circuit.

ELECTRICAL SHOCK

When your occupation requires you to work around electrical circuits, you should be prepared for an emergency. However, preventing yourself or another person from becoming a shock victim in the first place is much better. When you have reason to suspect a defect in an electrical unit, never touch it until the power has been turned off. After you turn the power off, place a sign on the unit to let others know the unit is defective and why the power is off. If you discover a shock victim near electrical equipment, disconnect the equipment from its power source first. Never touch the equipment while you are doing this. Do what you can to help the victim when you are certain that the victim is free of any electrical contact. If it is necessary to loosen a shock victim from contact with an electrical circuit, a nonconductive object like a long wooden stick should be used to pry the victim away. This should be done only as a last resort.

If a shock victim is not breathing, get help from an Emergency Medical Service (EMS) unit. Artificial respiration should be administered as soon as possible. You should learn the procedure of cardiopulmonary resuscitation (CPR) so you will be prepared for such an emergency.

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Safety

TOPIC: Electrical Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this assignment sheet, the student will be able to:

1. explain how to work on energized electrical equipment without receiving a shock; and
2. tell what to do when a shock victim is discovered near electrical equipment.

REFERENCE: Student Information Sheet/Electrical Safety

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What two safety precautions should be practiced when working on energized equipment to avoid becoming a shock victim?

    a.

    b.

2. What three actions should be taken if a shock victim is found near electrical equipment?

    a.

    b.

    c.

3. What is an electrical circuit called when it is connected with the power on?

4. What should be used to break a shock victim loose from an electrical contact?

JOB SHEET

AIR CONDITIONING AND REFRIGERATION

NAME:______________________________ **DATE:**______________________

UNIT: Safety

NAME OF JOB: Working With Energized Circuits

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the proper technique for working with an energized circuit.

TOOLS AND EQUIPMENT: Air conditioning cabinet or substitute fixture

MATERIALS: No materials are required

GENERAL INSTRUCTIONS: Following instructions given in class, demonstrate the proper technique for working with an energized circuit.

PROCEDURES AND/OR TASKS:

1. Place one hand behind your back or in your pocket.
2. With the other hand, reach inside the cabinet as you would if the circuit were energized (avoid touching live connections).

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Careers in Air Conditioning and Refrigeration

TOPIC: Customer Relations

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. tell why it is important for an employee to be familiar with company policies;
2. give the personal characteristics that are important for an employee to have in working with customers;
3. explain what course of action to follow when dealing with an irate customer; and
4. explain how an understanding of customer attitudes can be beneficial to an employee.

Customer Relations

Good customer relations begin with good relations between you and your employer. Be sure you understand your employer's position on all issues that might affect customer relations. If you are uncertain about anything, do not hesitate to ask questions. It could be embarrassing if a customer should ask you a question about company policy that you could not answer. Even though you may not always agree with your employer's point of view, you should remember that he or she is still in charge. When you are loyal to your employer, the customer will see your loyalty as a positive attitude. If you find you cannot remain loyal to an employer, you should find another job and then resign from your old job.

Personal Characteristics

While your ability to do a good job will be appreciated by both employers and customers, ability must be accompanied by characteristics like initiative, resourcefulness, and honesty. The ability to work with and get along well with others is of utmost importance. Since, to the customer, you represent the company you work for, you must be especially careful of how you act and what you say around customers. Profanity should never be used around customers.

Relationship with the Customer

A common reason for job dismissal is the employee's inability to get along with others. The old adage "the customer is always right" is one to remember. However, if the customer has an erroneous idea about company policy, it is your responsibiltiy to give the correct explanation in a courteous manner. Be friendly with customers, but be careful of appearing overly friendly. The customer, who is paying for your service, will appreciate your businesslike attitude. Never waste time in the attempt to appear friendly by talking too much about such topics as the local baseball team, if it could leave the customer feeling that your attention was not focused on the work you were doing. Of course, when you report for work you should always present a clean, neat appearance.

In personal relationships with others, whether customers or fellow workers, you should be tolerant of their faults. We all have faults, and a habit we have might be quite disagreeable to someone else. For example, smoking often offends nonsmokers. There are times when a customer may become irate about something and take it out on you. The best thing to do in such instances is to avoid an argument. Answer direct questions in an honest and friendly way, but say no more than is necessary, until the customer cools down.

Attitudes Affect Behavior

We all tend to respond in either a positive or a negative manner toward certain persons, objects, or situations. When we do this, we display an attitude that is obvious to others. Attitudes are not entirely under our own control. However, understanding how important attitudes are to a person's behavior can help you deal more successfully with customers.

Whether you are consciously aware of them or not, you have already developed many attitudes. For example, you have an attitude toward teachers, an attitude toward salespeople, an attitude toward athletes, and an attitude toward auto mechanics.

Our attitudes control our behavior in many situations. For example, if you were installing equipment in a dignified woman's home, she would probably not appreciate hearing about events at the local pool hall. Noticing the characteristics of the person you are dealing with can often help you predict his/her attitudes. This knowledge can help you avoid offending a customer by saying the wrong thing.

To understand how attitudes can be changed, you should realize that attitudes are formed by our life experiences. Attitudes can be changed through new experiences. If a customer has had an encounter with a discourteous representative from your company, you have the opportunity to change or, at least, modify that customer's attitude. To do this, you should provide the customer with a new experience. If you are courteous and show a great deal of concern for the customer, this may cause the customer to have a more favorable attitude toward the company in the future. Remember that you will rarely get people to change their behavior by just telling them to change it. When we ask people to change their way of doing things, we must show how the new behavior will help them. For example, in a customer's home, you might discover a puddle of water on the floor is in contact with an electric appliance. When you explain to the customer how this is a safety hazard that could result in a fatal shock, the customer will wipe it up and be grateful to you. If you just said, "That puddle should be cleaned up," you would only make the customer mad.

A person's habits can be compared to the underwater portion of an iceberg. The small part of an iceberg above the water can be compared to the part of our lives that is under our conscious control.

The large mass of the iceberg under the surface of the water can be compared to the part of our life that is controlled by habit. Habits are necessary, and are often helpful to us. If you put forth the effort, you can develop good habits for dealing with customers that will result in better customer relations.

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ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ **DATE**__________

UNIT: Introduction to Careers in Air Conditioning and Refrigeration

TOPIC: Customer Relations

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet the student will be able to:

1. tell why it is important to be familiar with company policies;
2. give the personal characteristics that are important for an employee to have in working with customers;
3. explain what course of action to follow when dealing with an irate customer; and
4. explain how an understanding of customer attitudes can be beneficial to an employee.

REFERENCE: Student Information Sheet/Customer Relations

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. Why should you be concerned with company policy?

2. What are several personal characteristics that are appreciated by customers and employers?

3. How should you deal with an irate customer?

4. How should you deal with a customer who has a negative attitude toward your company?

5. What should you do if you find it is impossible for you to be loyal to your employer?

6. What is a common reason for job dismissal?

7. How can attitudes be changed?

8. What does a customer usually appreciate from you?

9. What usually controls our behavior?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Careers in Air Conditioning and Refrigeration

TOPIC: Occupational Outlook

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. discuss the type of work air-conditioning and refrigeration mechanics perform;
2. list four occupational hazards in the air-conditioning and refrigeration trade;
3. tell where the majority of air-conditioning and refrigeration mechanics find employment;
4. give the beginning qualifications for helpers or apprentices; and
5. give the occupational outlook for air-conditioning and refrigeration mechanics through the 1980's.

Today, the requirements of modern central air-conditioning and heating systems cause air-conditioning and refrigeration mechanics to be concerned with heating equipment as well as air-conditioning and refrigeration systems. The opportunity for year-round employment is much better if they are trained to install and maintain heating equipment also. These mechanics should understand and be able to work with the entire system. Air-conditioning and refrigeration mechanics should, at least, have an understanding of basic heating requirements related to air-conditioning and refrigeration work. For example, heat losses due to cracks around windows and doors and other sources of air leakage concern the air-conditioning and refrigeration mechanic as much as they do the heating mechanic. In fact, the basic process of cooling is accomplished by removing heat from the air, not by adding cold. Air-conditioning and heating systems control the humidity, temperature, and cleanliness of the air in homes, schools, and office and industrial buildings. Refrigeration systems are necessary for storing perishable items.

Kind of Work Done

The installation and service of central air-conditioning systems and refrigeration equipment is performed by air-conditioning and refrigeration mechanics. They are required to be able to read and work from blueprints and manufacturers' specifications when installing condensing units, evaporators, motors, compressors, and other related components. All of this equipment must be connected to air ducts, refrigerant lines, and electrical power lines. When the system has not been charged with refrigerant at the factory, it must be done at the job site and then checked for proper operation.

During the winter, some air-conditioning and refrigeration mechanics service heating systems. Of course, most of their work is done in the summer when air-conditioning and refrigeration equipment is more likely to break down. Defects in the systems are detected by making special tests on thermostats, relays, compressors, and other components. Air-conditioning and refrigeration mechanics must maintain and inspect the systems. They may be required to do such maintenance jobs as overhauling compressors. Sometimes, the parts are taken to a shop where it is more convenient to perform the maintenance or repair job. For this reason, these mechanics must also be familiar with maintenance-shop routines.

Working Conditions

One job requirement for air-conditioning and refrigeration mechanics is to travel back and forth from the repair shop to various job sites. They must transport spare parts and tools. Their trucks often have two-way radios to maintain communication between the job site and the shop.

Whether the work is done in homes, offices, or industrial buildings, mechanics often work in uncomfortable situations. They may need to work in buildings where the air-conditioning or heating system has completely broken down. They may work outside in cold or hot weather as well as in high places. Since there are many hazards in this occupation, it is very important to practice safety on the job at all times. The job requires lifting heavy equipment and using welding equipment. Working around electrical equipment on the job also presents the hazard of possible electrical shock.

Places of Employment

Air conditioning and refrigeration mechanics are employed in all parts of the United States. These mechanics work for school systems and other institutions. They also work for other organizations that operate large air-conditioning, refrigeration, or heating systems. In the warm areas of the southern United States, air-conditioning and refrigeration mechanics may also work for local dealers who install and maintain only air-conditioning units the year-round.

Qualifications and Advancement

Training in air-conditioning and refrigeration is offered by many secondary schools, private vocational schools, and junior colleges. However, it takes four or five years on the job for a mechanic to be able to do all types of repair or installation that might be necessary on the job. The majority of these mechanics begin as helpers and acquire their skills by working several years with experienced mechanics.

The unions, and air-conditioning and heating contractors provide apprenticeship programs. Apprentices receive 144 hours of classroom instruction in addition to on-the-job training. They study such subjects as blueprint reading, safety practices, air-conditioning theory, and the use and care of tools. The apprenticeship program lasts four years. Applicants for apprenticeship programs must be high-school graduates and must pass a mechanical aptitude test.

To qualify for an entry-level job in the air-conditioning and refrigeration field, you must be in good physical condition. Sometimes, it is necessary to lift and move heavy equipment on the job. Courses in mechanical drawing, mathematics, electricity, physics, and blueprint reading are helpful. In general, employers are looking for high-school graduates with mechanical aptitude.

Advanced courses to keep up with changes in technology and improve skills of experienced mechanics are offered by several associations. The Air-Conditioning Contractors of America, the Refrigeration Service Engineers Society, and the Petroleum Marketing Education Foundation offer advanced courses for experienced mechanics.

Opportunities for advancement include the possibility of becoming a supervisor or opening your own contracting business. Those who start their own business should have managerial skills. They must also have enough money to pay the overhead bills until the business starts to show a profit.

Employment Outlook

Through the 1990s the employment of air-conditioning mechanics is expected to increase at the same rate as the average for all occupations. As experienced mechanics transfer to other fields, retire, or die, openings will occur. Employment of these mechanics also increases as new energy-saving air-conditioning systems are installed in existing homes and buildings. New construction of buildings also increases the need for more air-conditioning mechanics. Mechanics with the most hands-on experience will be preferred over others. The need for such mechanics is strong even during economic downturns.

Wages and Hours

In the 1990s, the hourly rate for experienced air-conditioning and refrigeration mechanics working under union contracts was $12 to $15 per hour. Apprentices receive about 40 percent of the wage paid experienced mechanics. The percentage increases to about 85 percent by the fourth year of apprenticeship. Mechanics who can also work on heating equipment receive higher pay than those who can work only on air-conditioning and refrigeration equipment.

In shops that service both air-conditioning and heating equipment, employment is stable throughout the year. There are, however, seasonal slumps when work hours may be reduced and some mechanics may be laid off. Most mechanics ordinarily work 40 hours a week, but occasionally they may have to work overtime.

Sources of Additional Information

To receive more information about employment and training of air-conditioning, refrigeration, and heating mechanics, write to the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry. Information is also available from the Sheet Metal Workers International Association.

You can request pamphlets on career opportunities and training by writing to the:

Air-Conditioning and Refrigeration Institute
1815 N. Fort Myer Dr.
Arlington, VA 22209

Air-Conditioning Contractors of America
1228 17th St., N.W.
Washington, D.C. 20036

Information regarding training in oil heating systems can be obtained by writing to the:

Petroleum Marketing Education Foundation
P.O. Box 11187
Columbia, SC 29211

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ **DATE**__________

UNIT: Introduction to Careers in Air Conditioning and Refrigeration

TOPIC: Occupational Outlook

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to:

1. discuss the type of work air-conditioning and refrigeration mechanics perform;
2. list four occupational hazards in the air-conditioning and refrigeration trade;
3. tell where the majority of air-conditioning and refrigeration mechanics find employment;
4. give the beginning qualifications for helpers or apprentices; and
5. give the occupational outlook for air-conditioning and refrigeration mechanics through the 1990's.

REFERENCE: Student Information Sheet/Occupational Outlook

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What units are repaired and installed by air-conditioning and refrigeration mechanics?

2. Give the locations where these mechanics do their jobs.

3. What special tests and maintenance jobs are performed by air-conditioning and refrigeration mechanics?

4. Name four occupational hazards for air-conditioning and refrigeration mechanics.

5. Who employs most air-conditioning and refrigeration mechanics?

6. What is the occupational forecast for air-conditioning and refrigeration mechanics through the 1990's?

7. Why is it sometimes necessary to take air-conditioning or refrigeration units or parts to a shop?

8. How many hours of classroom instruction are received by apprentices?

9. What are the opportunities for advancement?

10. What is the hourly wage of union air-conditioning and refrigeration mechanics?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT:	Introduction to Air Conditioning and Refrigeration
TOPIC:	Understanding Basic Electricity
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to demonstrate an understanding of basic electricity.

When working in air conditioning and refrigeration it is important that you understand how electrical circuits function and the basic laws that govern them. The word **ELECTRICITY** is commonly used to mean the flow of electrons through a conductor or the flow of current. There are two different types of current. One type, **DIRECT CURRENT** (DC), always flows in a continuous path in the same direction. The other type is called **ALTERNATING CURRENT** (AC) because the flow of current changes direction at regular intervals.

Direct Current (DC)

In a direct-current circuit, according to modern electron-flow theory, the flow of current is from a negative terminal to a positive terminal. In figure 1, a battery is used as the source of direct current. The symbol for a battery, as shown, has a short line representing the negative terminal and a long line at the bottom representing the positive terminal. The term **LOAD** is used to represent any electrical device that will perform a task when the current is allowed to flow through it. You can tell by the direction of the arrows that as long as there is no break in the wire conductor (that is, the circuit is not "open") the current will flow continuously from the negative terminal to the positive terminal. The advantage of direct current is that it provides a consistent level of current because it does not lose efficiency due to change in direction. Since alternating current continuously changes directions, a continuously changing magnetic field is created, which leads to inefficiency.

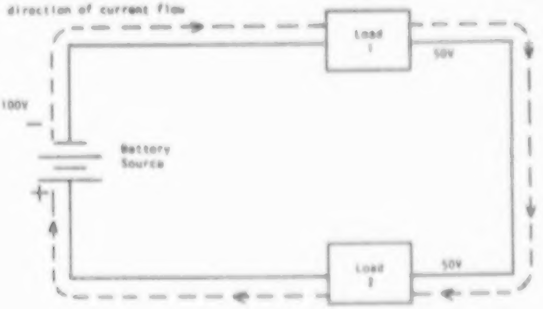


Figure 1. DC series circuit

Alternating Current (AC)

Certain disadvantages of direct current are overcome by the use of alternating current. When current must be moved a long distance--for example, from a large generating plant to various sections of large cities--it is more economical to use alternating current. For such a large network of electrical distribution, transformers must be used to step down and step up the levels of current and voltage that are needed. This is not possible with direct current. If direct current were fed into a transformer, no output current would be produced because direct current is continuous and constant in one direction only, and transformers require changes in current directions to effect a change in voltage.

The most common form of alternating current used in the United States is 60 cycles per second current, or, 60 hertz (Hz), which means the current travels from the AC power plant to the electrical consumer and back to the power plant 60 times in one second. In other words, the current changes direction 120 times in one second. Figure 2 depicts this as an AC sine-wave curve.

The AC graphical representation in figure 2 is for common 110-volt (V) household current. As the AC current leaves the AC generator at the power plant, the **VOLTAGE**--the force causing the current to move through conductive wires--climbs from zero potential to a peak of 110 V during the positive half cycle. This happens in the first quarter of the cycle. In the second quarter of the cycle, the voltage gradually decreases to zero potential. It then changes direction (goes negative) to begin the third quarter of the cycle. It gradually increases in value until it reaches the maximum or peak value of 110 V negative. In the last quarter of the cycle, the negative voltage gradually decreases, until it returns to zero potential and is ready to change direction and start a new cycle. Remember that it completes 60 of these complete cycles in one second. Whichever direction the current is going, whether it is the positive half cycle or the negative half cycle, it is providing electrical energy for use.

A DC voltage of 110 V will remain a constant value. There are no fluctuations once the switch is turned on for a DC electrical appliance. The voltage jumps instantly to 110 V and remains at the value until the switch is turned off, breaking the circuit. You can easily see why DC voltages are more efficient than AC voltages.

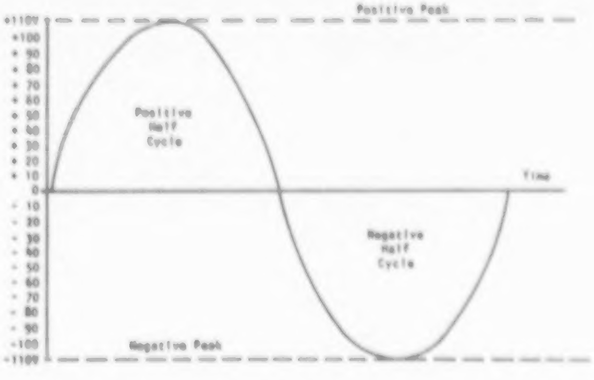


Figure 2. AC-voltage sine wave

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ DATE__________

UNIT:	Introduction to Air Conditioning and Refrigeration
TOPIC:	Understanding Basic Electricity
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will demonstrate an understanding of basic electricity.
REFERENCE:	Student Information Sheet/Understanding Basic Electricity
DIRECTIONS:	Read and answer each of the following questions in the space provided.

1. How is direct current different from alternating current?

2. What is the advantage of using direct current instead of alternating current?

3. What is the advantage of using alternating current instead of direct current?

4. How many times does alternating current change in one second?

5. What is the force that causes current to move through conductive wires?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Hand Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

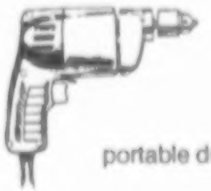
SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify air conditioning and refrigerations tools.

There are many types of tools used when working in air conditioning and refrigeration. It would be impossible to learn all the uses of the various tools in a short period of time. However, in order to understand the types of jobs performed in air conditioning and refrigeration, it is important that you become familiar with the tools required and with their basic function.

A brief statement is provided along with pictures of these tools. Study each picture along with each description. Being able to recognize and choose the necessary tools is important.

Drilling Tools

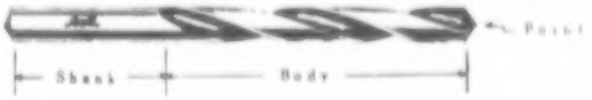
Several types of portable electric drills are commonly used. When a large number of holes must be drilled, a **PNEUMATIC DRILL**, powered by compressed air pressure, is used to save time.



portable drill

Drill Bits

A common drill bit for drilling metal is called a twist drill. The three main parts of a twist drill are the shank, the body, and the point.

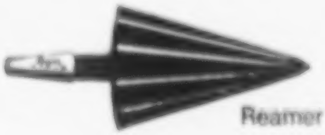


drill bit

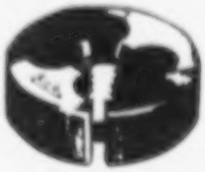
Threading and Reaming Tools

In order to make a perfectly round hole, the hole is drilled undersize with a twist drill. **A REAMER** is then used to cut the hole to specifications. A threading tool is used along with the reamer. The threading tool used to cut threads inside a hole is called a TAP. If outside threads are needed a **HAND DIE** is used.

Tap



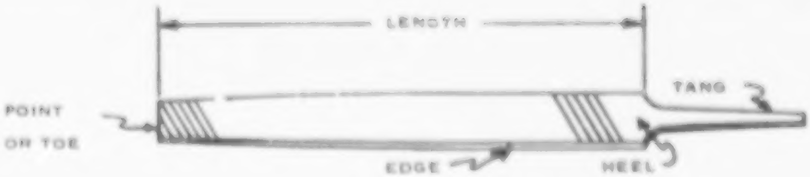
Reamer



Hand die

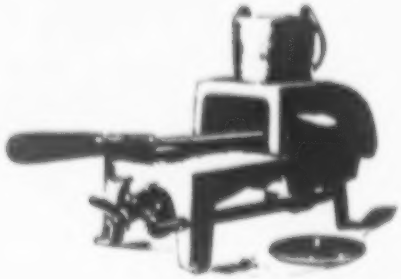
Files

A file is used to remove excess material .

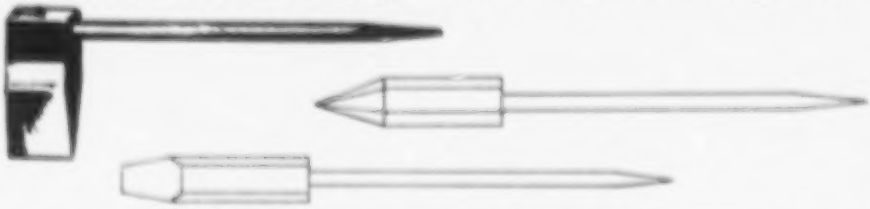


Soldering Tools

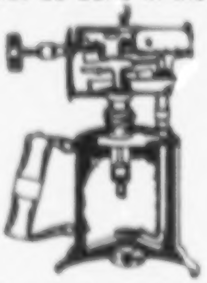
Soldering work in the shop is done with a **SOLDERING FURNACE**. A soldering furnace connects to a natural gas line inside the building.



Semipermanent joints are made by using special tools called **SOLDERING COPPERS**.



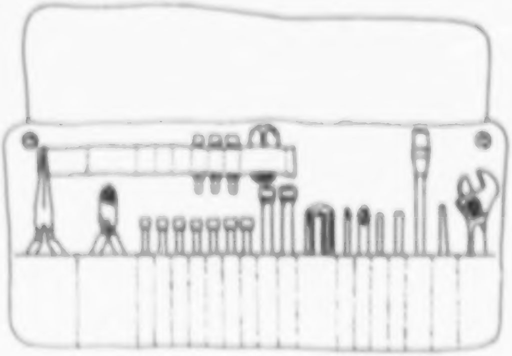
When soldering work cannot be done in the shop, a portable **BLOWTORCH** or **ELECTRIC SOLDERING COPPER** is used.



General Hand Tools

In addition to the metalworking tools previously described, an air-conditioning and refrigeration mechanic must own and maintain such common hand tools as hammers, pliers, and screwdrivers, as well as a complete set of wrenches, both adjustable and nonadjustable. The nonadjustable wrench set should include box, open-end, socket, and spanner wrenches.

Service kits that contain most of the common hand tools are available. The tools in such kits are stored in a lightweight roll-up canvas case. The service kit contains various screwdrivers, nut drivers, and other blades that can be used interchangeably with the same handles. The kit also contains needle-nose pliers and diagonal-cutting pliers (to the left of the nut-driver set). The tool to the extreme right is a cushion-grip adjustable wrench, which replaces many nonadjustable wrenches.



ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME______________________________ **DATE**__________

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Hand Tools

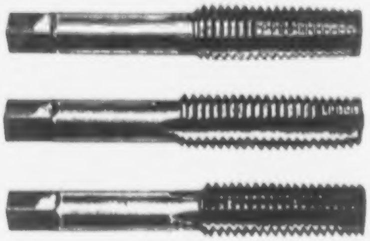
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to identify air conditioning and refrigeration tools.

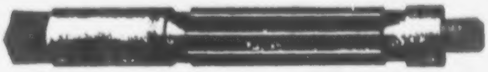
REFERENCE: Student Information Sheet/Hand Tools

DIRECTIONS: Identify each of the air conditioning and refrigeration tools shown by placing the correct letter in the blank.

A. Twist Drill
B. Cleveland Spiral Fluted Hand Reamer
C. Taper Socket Reamers
D. Standard Taper Pin Reamers
E. Bit Stock Taper Reamer
F. Straight Fluted Burring Reamer
G. Expansion Reamer
H. Adjustable Reamer
I. Hand Taps
J. Hand Dies
K. File
L. Soldering Coppers
M. Soldering Furnace
N. Portable Blowtorch
O. Chucking Reamer
P. Adjustable Tap and Reamer Wrench



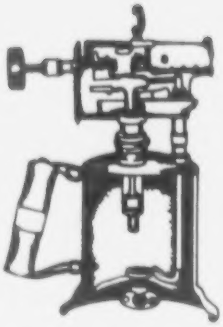
1. ___



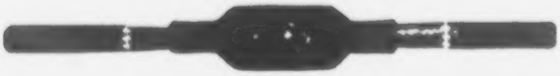
2. ___

3. ___

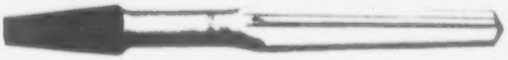
4. ___



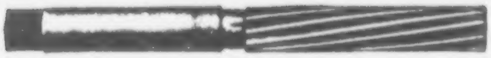
5. ___



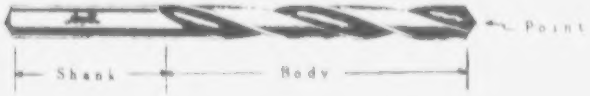
6. ___



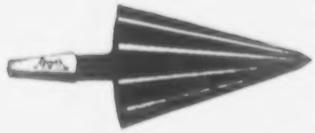
7. ___



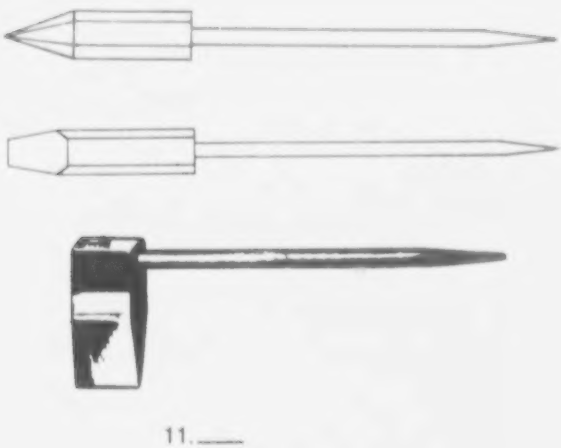
8. ___


Point
Shank
Body

9. ___

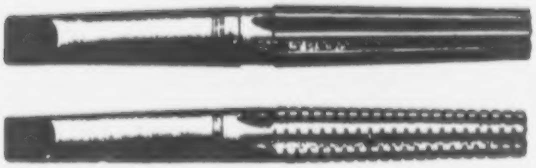


10. ___

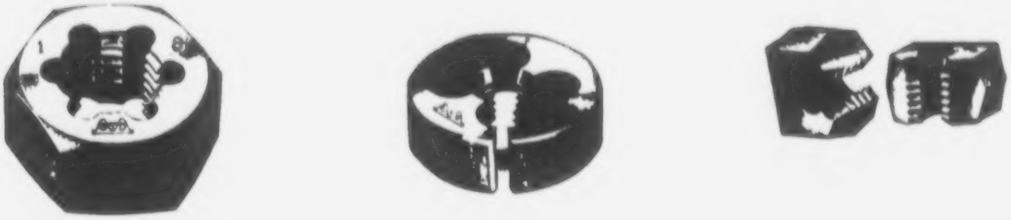


11. ___

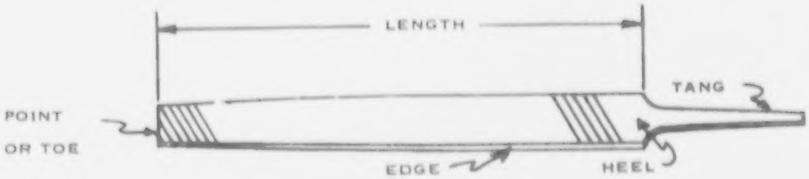
12. ____



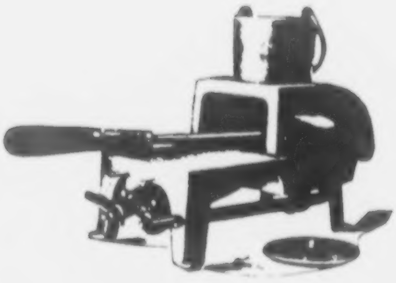
13. ____



14. ____


LENGTH
TANG
POINT
OR TOE
EDGE
HEEL

15. ____



16. ____

JOB SHEET

AIR CONDITIONING AND REFRIGERATION

NAME:______________________________ **DATE:**______________________

UNIT:	Introduction to Air Conditioning and Refrigeration
NAME OF JOB:	Using Hand Tools
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	In completing this job sheet, the student will demonstrate the ability to use one hand tool.
TOOLS AND EQUIPMENT:	Display of hand tools used in air conditioning and refrigeration
MATERIALS:	No materials are required
GENERAL INSTRUCTIONS:	Following instructions given in class, demonstrate the use of one hand tool.

PROCEDURES AND/OR TASKS:

1. Select one tool from the display.
2. Following correct safety procedures, demonstrate how the tool should be used.
3. Replace the tool.

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Refrigerant Tools and Equipment

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify refrigerant tools and equipment.

Special tools and equipment are needed for working with the refrigerant in an air conditioning or refrigeration system. Using these tools and equipment requires a great deal of knowledge and care. Following are examples of tools and equipment used in working with refrigerant.

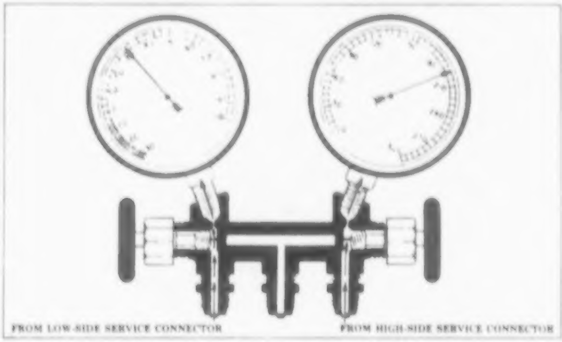

FROM LOW-SIDE SERVICE CONNECTOR
FROM HIGH-SIDE SERVICE CONNECTOR

Figure 1. Refrigerant flow to gauges in performance test, with both hand valves closed.

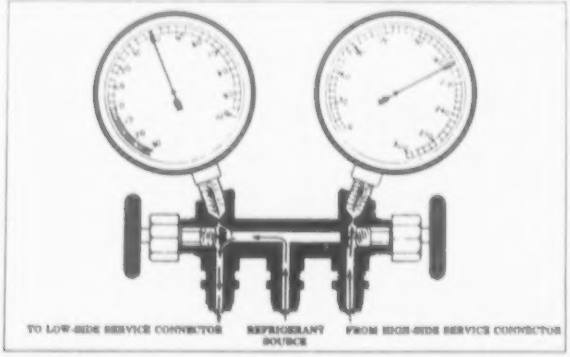

TO LOW-SIDE SERVICE CONNECTOR
REFRIGERANT SOURCE
FROM HIGH-SIDE SERVICE CONNECTOR

Figure 2. Refrigerant flows to the gauges and through the manifold while adding refrigerant with the system in operation.

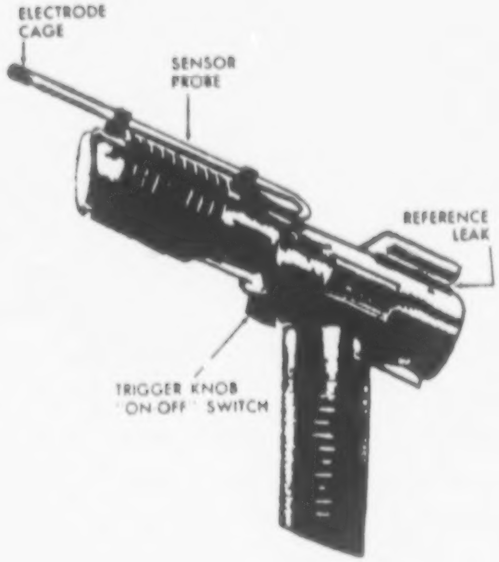

ELECTRODE CAGE
SENSOR PROBE
REFERENCE LEAK
TRIGGER KNOB "ON-OFF" SWITCH

Figure 3. Electronic leak detector

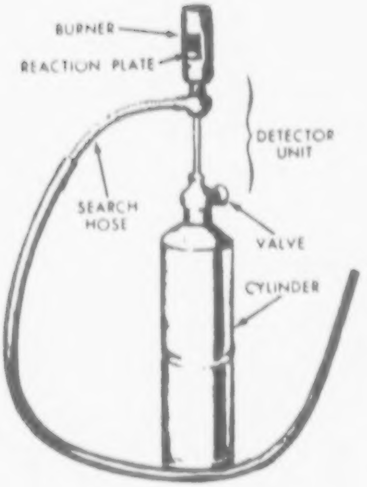

BURNER
REACTION PLATE
DETECTOR UNIT
SEARCH HOSE
VALVE
CYLINDER

Figure 4. Halide leak detector

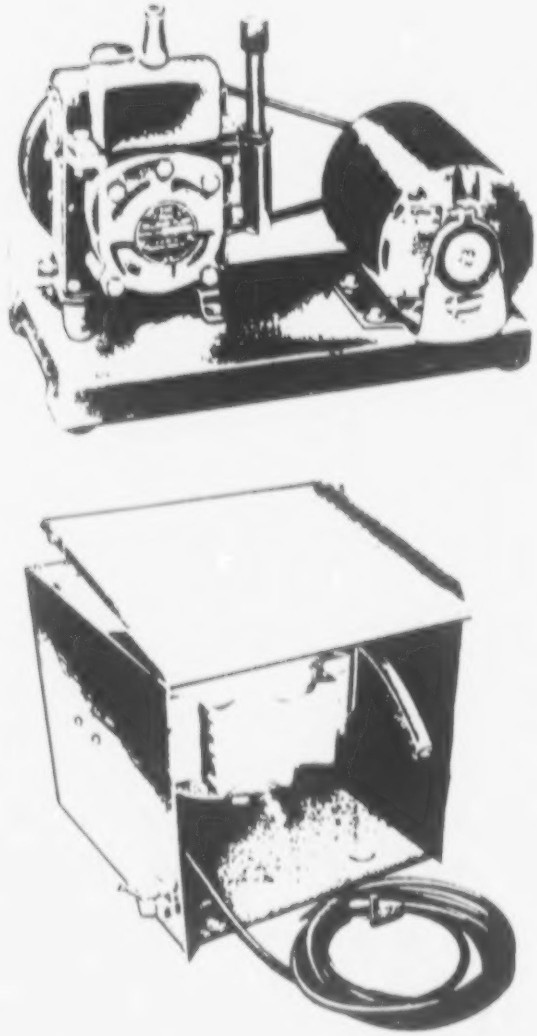


Figure 5. Two kinds of vacuum pumps

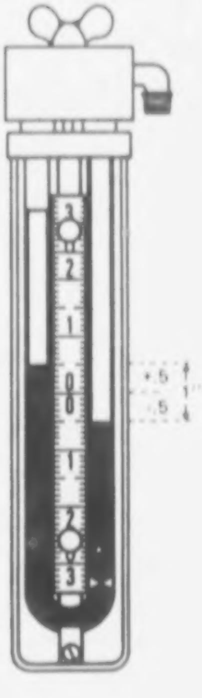

3
2
1
0
0
1
2
3
.5
1"
.5

Figure 6. Mercury manometer

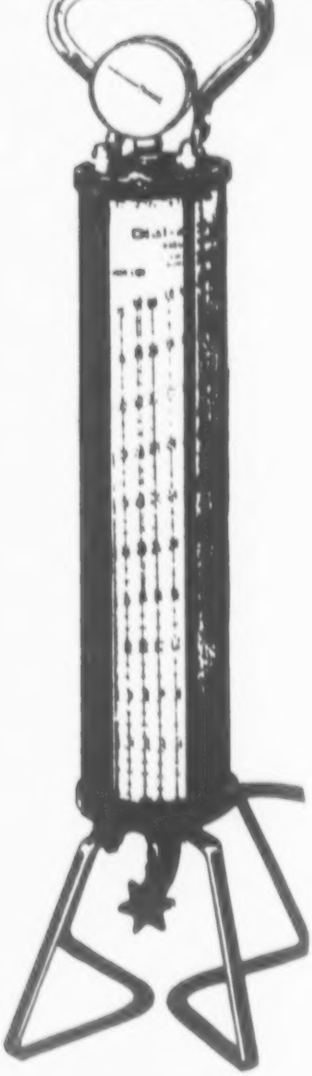


Figure 7. Portable calibrated charging cylinder

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ **DATE**__________

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Refrigerant Tools and Equipment

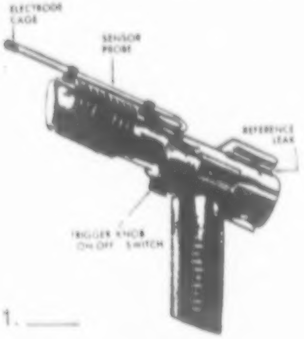
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate the ability to identify refrigerant tools and equipment.

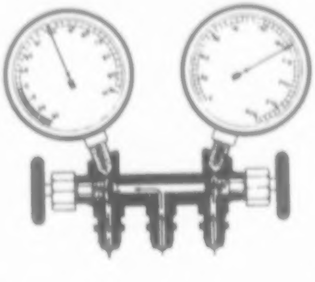
REFERENCE: Student Information Sheet/Refrigerant Tools and Equipment

DIRECTIONS: Identify each of the refrigerant tools and equipment shown by placing the correct letter in the blank.

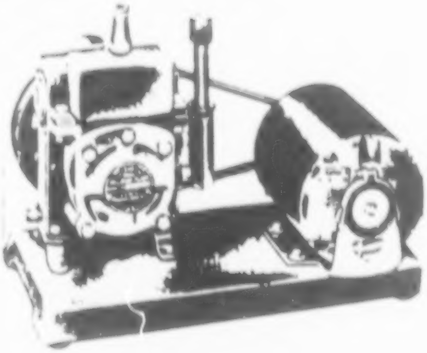
A. Mercury manometer
B. Halide leak detector
C. Portable calibrated charging cylinder
D. Electronic leak detector
E. Vacuum pump
F. Test gauge


ELECTRODE CAGE
SENSOR PROBE
REFERENCE LEAK
TRIGGER KNOB ON-OFF SWITCH

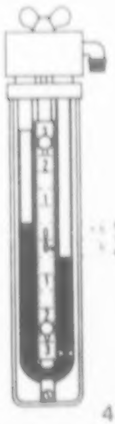
1. ____



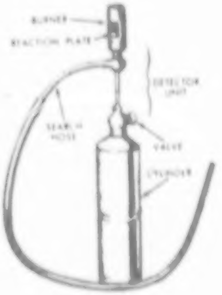
2. ____



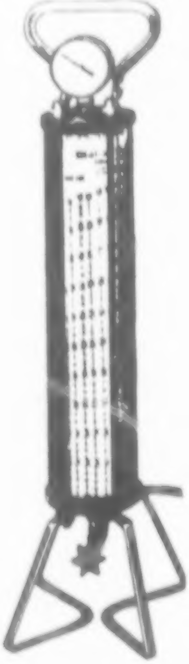
3. ____



4. ____


BURNER
REACTION PLATE
DETECTOR UNIT
SEARCH HOSE
VALVE
CYLINDER

5. ____



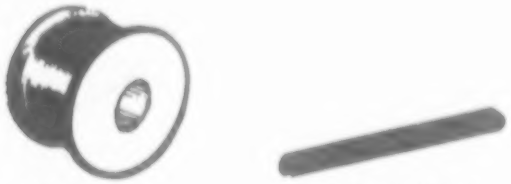
6. ____

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT:	Introduction to Air Conditioning and Refrigeration
TOPIC:	Materials Used In Air Conditioning and Refrigeration
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to identify materials used in air conditioning and refrigeration work.

When working in the area of air conditioning and refrigeration, you will use many different types of materials. These materials cover a very wide range. It is important that you learn to recognize these materials. The most common materials you will use have been identified and pictured in order to assist you.



wire solder

bar solder

Figure 1. Kinds of solder

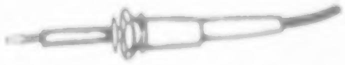


Figure 2. Pencil-type soldering iron

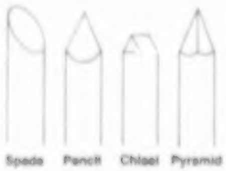


Figure 3. Common shapes of soldering tips

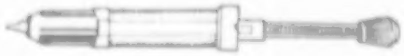


Figure 4. A desoldering tool

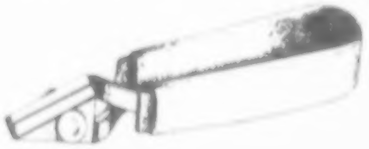


Figure 5. Heat sink

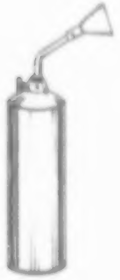


Figure 6. Propane gas torch

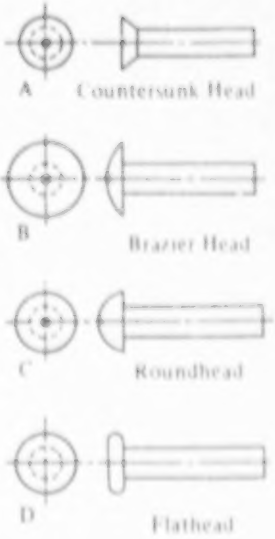

A
Countersunk Head
B
Brazier Head
C
Roundhead
D
Flathead

Figure 7. Common types of rivets

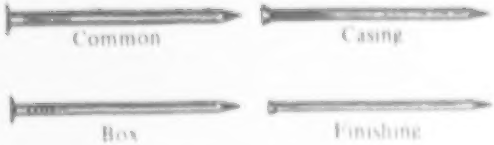

Common
Casing
Box
Finishing

Figure 8. Four common types of nails

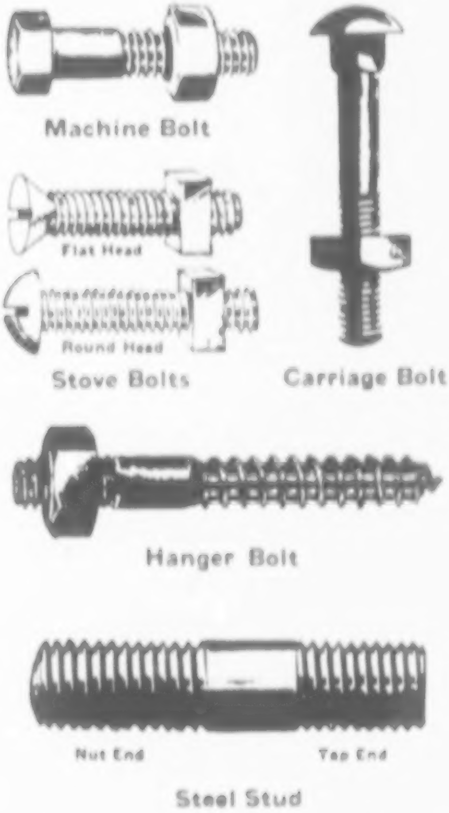

Machine Bolt
Flat Head
Round Head
Stove Bolts
Carriage Bolt
Hanger Bolt
Nut End
Tap End
Steel Stud

Figure 9. Common types of bolts

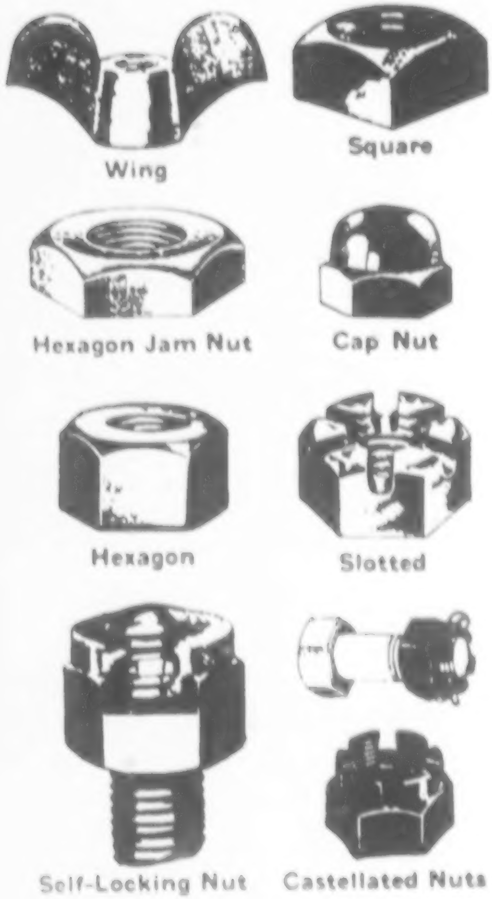

Wing
Square
Hexagon Jam Nut
Cap Nut
Hexagon
Slotted
Self-Locking Nut
Castellated Nuts

Figure 10. Common types of nuts

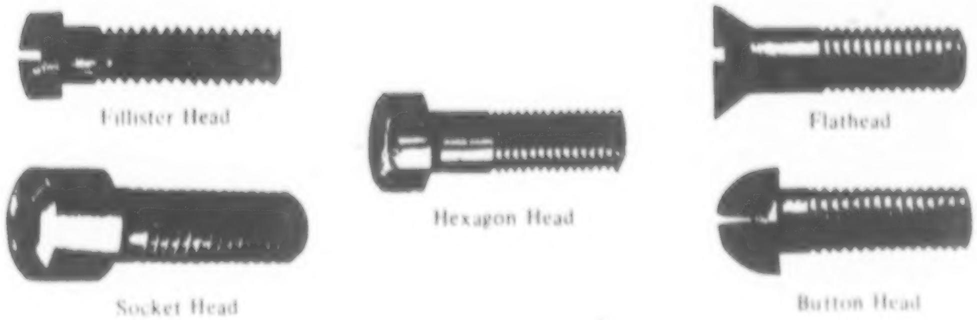

Fillister Head
Hexagon Head
Flathead
Socket Head
Button Head

Figure 11. Types of cap screws

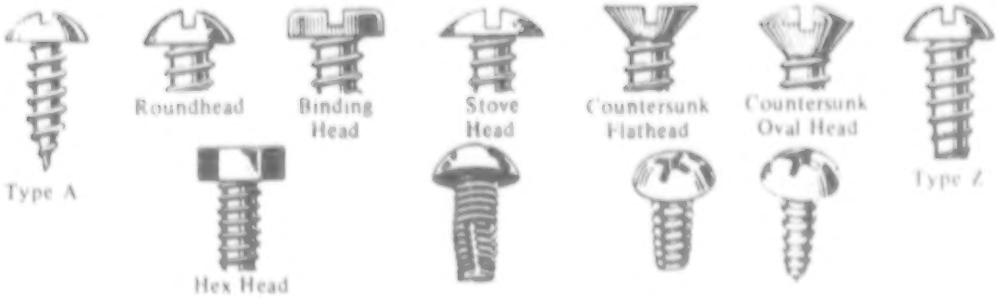
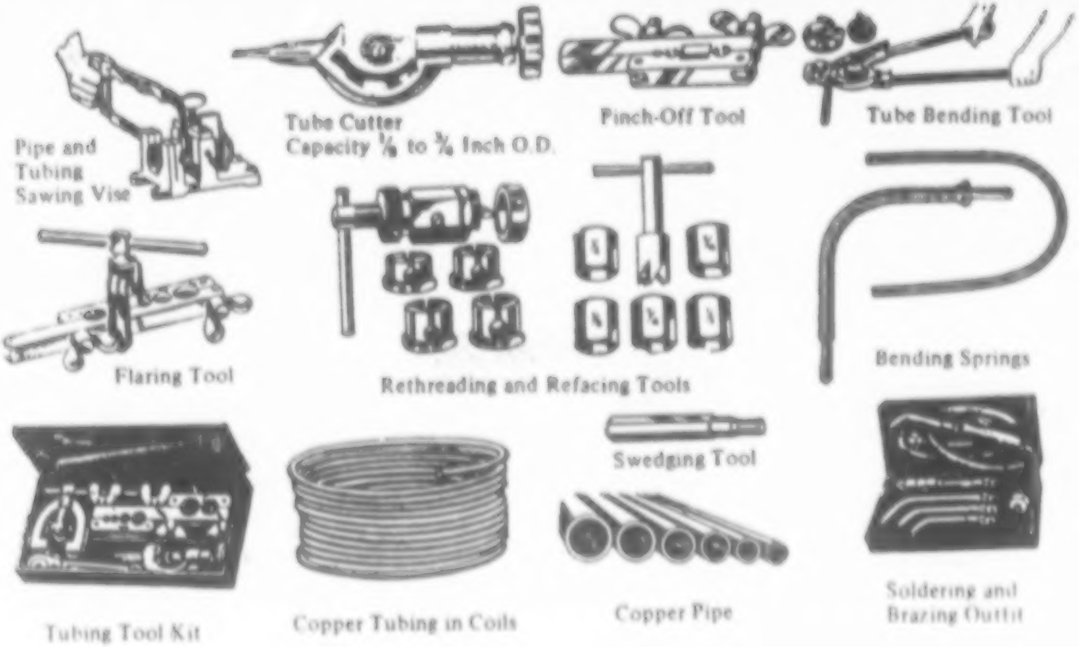
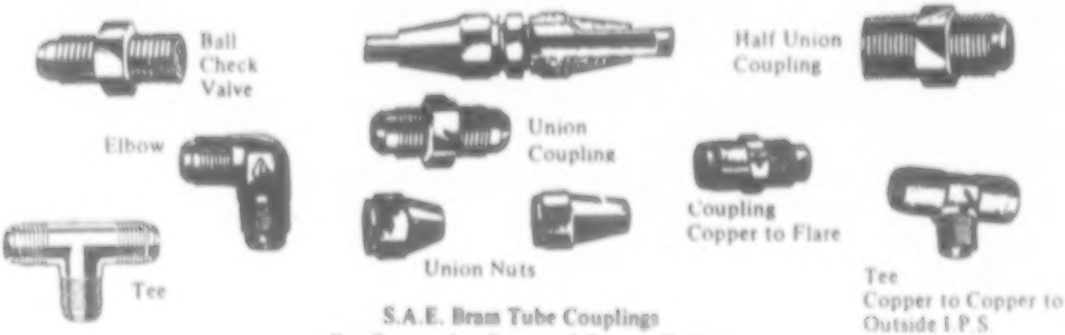
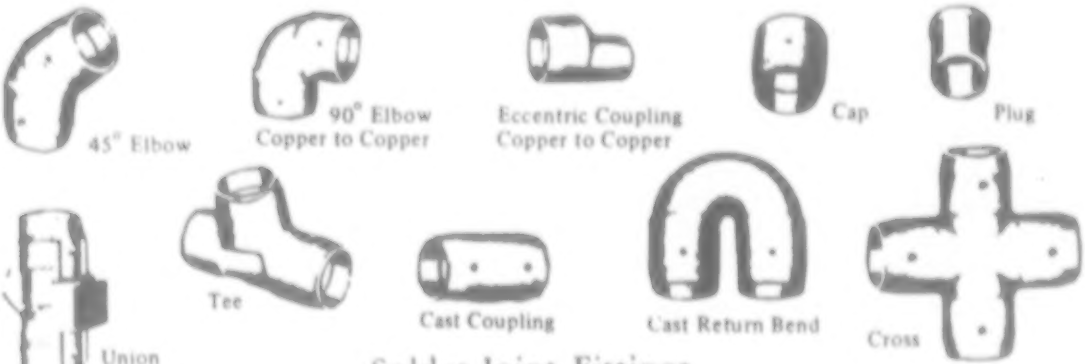

Type A
Roundhead
Binding Head
Stove Head
Countersunk Flathead
Countersunk Oval Head
Type Z
Hex Head

Figure 12. Self-tapping screws


Pipe and Tubing Sawing Vise
Tube Cutter Capacity ⅛ to ¾ Inch O.D.
Pinch-Off Tool
Tube Bending Tool
Flaring Tool
Rethreading and Refacing Tools
Bending Springs
Swedging Tool
Tubing Tool Kit
Copper Tubing in Coils
Copper Pipe
Soldering and Brazing Outfit


Ball Check Valve
Half Union Coupling
Union Coupling
Elbow
Coupling Copper to Flare
Tee
Union Nuts
Tee Copper to Copper to Outside I.P.S.

S.A.E. Brass Tube Couplings
For Connecting Brass and Copper Tubing


45° Elbow
90° Elbow Copper to Copper
Eccentric Coupling Copper to Copper
Cap
Plug
Union
Tee
Cast Coupling
Cast Return Bend
Cross

Solder-Joint Fittings

Figure 13. Tubing tools and tubing

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Materials Used in Air Conditioning and Refrigeration

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

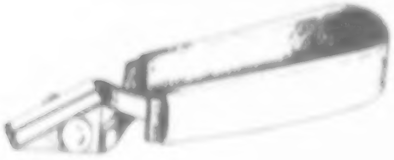
SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate the ability to identify materials used in air conditioning and refrigeration work.

REFERENCE: Student Information Sheet/Materials Used in Air Conditioning and Refrigeration

DIRECTIONS: Identify each of the air conditioning and refrigeration materials shown by placing the correct letter in the blank.

A. Desoldering tool
B. Pencil-type soldering iron
C. Wire solder
D. Common types of rivets
E. Common shapes of soldering tips
F. Common types of bolts

G. Common types of nuts
H. Heat sink
I. Types of cap screws
J. Self-tapping screws
K. Common types of nails



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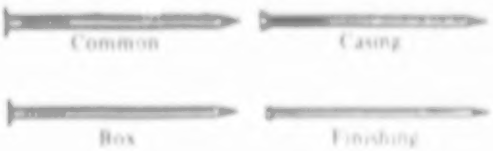

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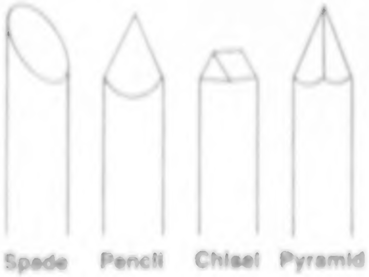

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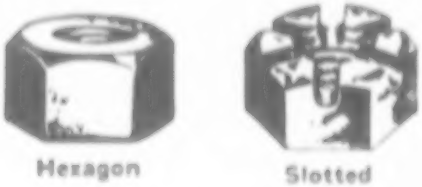

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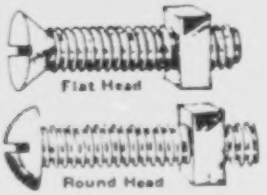
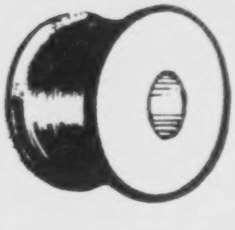

Flat Head
Round Head

5. ___



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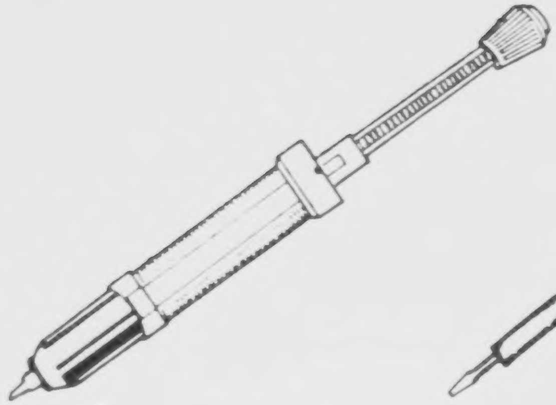

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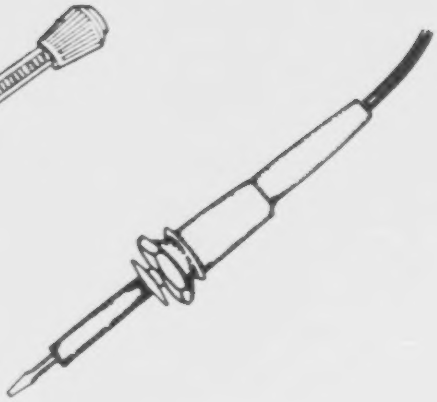

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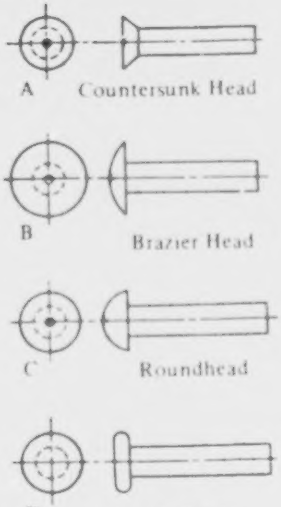
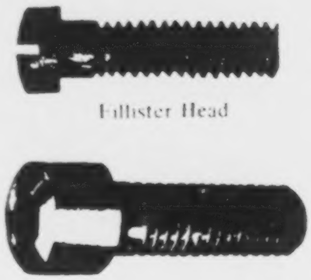

A Countersunk Head
B Brazier Head
C Roundhead
D Flathead

9. ___


Fillister Head
Socket Head

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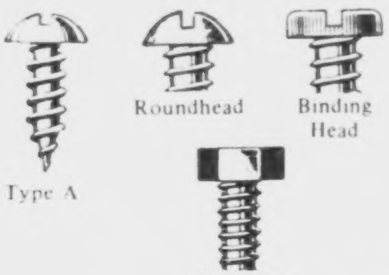

Type A
Roundhead
Binding Head
Hex Head

11. ___

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Understanding the Basic Concepts of Refrigeration

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to demonstrate a knowledge of the basic concepts of refrigeration.

A very basic concept of air-conditioning and refrigeration is that cooling is accomplished by the removal of heat. In this assignment, you will learn how important the interactions between refrigerants and heat are to the overall cooling process.

There are two types of heat. The first is **SENSIBLE HEAT**, also known as dry heat,which is the kind of heat that is felt or sensed. It can be measured by a thermometer. The second type of heat is **LATENT HEAT**. The hot steam vapor from a steam iron is an example of this. Latent heat is the heat required to evaporate water. The term used to include both types of heat is **TOTAL HEAT**.

Types of Refrigerants

To be used in a refrigeration system, a refrigerant should be noncorrosive to metal, have a low boiling point, have a high latent heat value, and be nontoxic. Under conditions of moderate pressure and temperature it should liquify easily. It should also mix well with oil and not be affected by moisture.

Three main types of refrigerants differ in the way they remove or absorb heat. The first type is used in all standard compressor systems. The most commonly used refrigerants are ammonia (NH_3), Freon-12, Freon-22, and Freon-502. These refrigerants may be listed by trade names or abbreviated. For example, Freon-12 and Freon-22 are also known as Ucon-12 and Ucon-22, or simply as R-12 and R-22. All of the refrigerants in this class perform cooling by removing or **ABSORBING LATENT HEAT**.

Refrigerants of the second type are used in conjunction with type-1. These nonfreezing solutions--composed of sodium chloride (salt), calcium chloride, and alcohol--cost less than type-1 refrigerants. Since they are mixed with type-1 in the same cooling unit, a smaller amount of the type-1 refrigerant is needed to fill the system. This mixture results in better overall efficiency as well. While the type-1 refrigerant is removing latent heat, the type-2 refrigerant is **REMOVING SENSIBLE HEAT**. Remember that the **TOTAL HEAT** is removed only when both latent heat and sensible heat are removed or absorbed from the system.

The third type of refrigerant includes solutions such as lithium bromide and ammonia. Water is used with them to aid absorption. These solutions carry liquifiable vapors that produce the cooling effect by absorbing latent heat.

Heat Loss

When air-conditioning and heating systems are designed, consideration must be given to **HEAT LOSSES** due to cracks around windows and doors. Fireplaces, chimneys, and all other sources of air leakage must be taken into account. Before any cooling unit is installed, an estimate should be made of the probable heat loss to be expected in that particular area. The ordinary heat loss to be expected for various building materials can be estimated using tables provided by the construction industry. The heat loss for one square foot of exposed surface of various wall, floor, and ceiling materials is given in terms of British thermal units (Btu) per hour per degree of Fahrenheit temperature difference. **Btu** is the term most commonly used for cooling power or capacity to cool. A Btu represents the amount of heat needed to raise the temperature of one pound of pure water 1 degree Fahrenheite. To melt one ton of ice in one hour, about 12,000 Btu would be needed. The term used to indicate the capacity of an air-conditioning unit is the **ton**, which is not an accurate unit of measure, but only an approximation. A one-ton cooling unit can remove about 12,000 Btu of heat in one hour. However, you will hear the term Btu/hour or just Btu used quite often.

Handling Refrigerants

Avoid inhaling the gases emitted from refrigerants. While the most commonly used refrigerants are nontoxic when there is adequate ventilation, the inhalation of fumes in closed-in areas can cause suffocation. Refrigerants like ammonia and sulfur dioxide can irritate bronchial organs and the lungs if the fumes are inhaled. To be on the safe side, a window nearby can be opened when working with refrigerants.

Avoid contact with refrigerants. If they come in contact with the skin, they can cause frostbite or even a frozen condition of the skin. Remember, refrigerant removes heat from whatever it contacts.

A person who has been exposed to a refrigerant should receive proper medical attention as soon as possible. If the victim is unconscious, artifical respiration should be given. After temporary first aid has been given, the victim should see a doctor.

Methyl Chloride

The chemical **METHYL CHLORIDE** is sometimes used as a refrigerant, and it warrants special care when you work with it. It is volatile and, hence, potentially explosive. In combination with other substances, it may be corrosive to the lungs. A person who has been exposed to an excessive amount of this refrigerant should be moved immediately to an area where there is fresh air. Then, call a doctor or the Emergency Medical Service (EMS). If the victim's eyes have come in contact with the chemical, an eye specialist should be called at once.

Storage and Care of Refrigerant Cylinders

Special precautions should be taken with refrigerant cylinders used to charge an air-conditioning system. They should always be stored in a horizontal position, and fastened securely by blocks. They should never be allowed to roll against each other. Never store them near oil, gasoline, or other flammable substances.

Always be certain that the correct regulators and gauges are used on the proper refrigerant cylinders. Forcing a connection of a regulator to a cylinder that does not fit properly will damage the threads. Use only the tools provided by the refrigerant manufacturer. Use the cylinders only for what they are intended. Remember, the cylinders are intended to hold refrigerant only.

Great care should be taken in the way cylinders are filled. Gases should not be mixed in a cylinder, and the cylinder must never be overfilled. A crane may be used to lift and move cylinders when a safe platform is provided for them, but use of a sling or lifting magnet should be avoided. When cylinders are not in use, they should always remain capped.

Transfer of Refrigerant

Special precautions should be observed when transferring refrigerant. Rubber gloves and goggles should be worn when transferring refrigerant from one container to another container, or into a system. You should watch the pressure gauges carefully during the charging of a system. **NEVER LET THE SYSTEM PRESSURE EXCEED THE CAN PRESSURE**. A canned refrigerant should never be connected to a system that has a gauge pressure over 260 pounds per square inch (psig). Refrigerant valves should always be **opened slowly**. Be certain that throw-away containers are never recharged. When steam cleaning must be done, or a welding torch used around a refrigerated system, be careful that the heat is not too close to the equipment. Excessive heat can cause system pressures that can be damaging to the system's components.

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Introduction to Air Conditioning and Refrigeration

TOPIC: Understanding the Basic Concepts of Refrigeration

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate a knowledge of the basic concepts of refrigeration.

REFERENCE: Student Information Sheet/ Understanding the Basic Concepts of Refrigeration

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What are the three basic types of heat?

2. How is the cooling function performed by type-1 refrigerants?

3. How is cooling performed by type-2 refrigerants?

4. How are type-2 refrigerants used in a cooling unit?

5. How can the heat loss for various materials be determined?

6. What health precautions should be taken while handling refrigerants?

7. Give the four safety rules regarding the storage of refrigerant cylinders.

8. Give the rules regarding the proper care of refrigerant cylinders.

9. What is used to measure sensible heat?

10. What are the characteristics of a good refrigerant?

11. What refrigerants are used in all standard compressor systems?

12. What refrigerant chemical warrants special care?

13. How should refrigerant valves be opened?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: Effects of Atmospheric Conditions on Air Conditioners

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be familiar with the effects of atmospheric conditions upon air conditioners.

Atmospheric conditions must be taken into consideration when working with air conditioners. In order to understand the effects of atmospheric conditions upon air conditioners, you must understand their effects on individuals first.

Natural surroundings affect the human body to a great extent. Humidity, temperature, and air circulation play significant roles in the process that maintains normal human body temperature at about 98.6° F.

Humidity

Heat is removed from the human body through the process of evaporation, by which heat changes a liquid into a vapor. When the moisture (perspiration) given off through the pores in the skin becomes a vapor, heat removed from the body is used to accomplish this change, and the body becomes cooler as a consequence.

The term for the amount of moisture in the air is **HUMIDITY**. When humidity is relatively low, heat is easily removed from the body by evaporation. Under conditions of low humidity the air is dry, and as a result it is able to absorb moisture more readily than under conditions of high humidity. The term **RELATIVE HUMIDITY** is used to mean the percentage of moisture the air is capable of holding at a given temperature. For example, when the air is holding about half of the moisture that it could hold for a particular temperature, the relative humidity is said to be at 50 percent. When the conditions are quite humid (high relative humidity), evaporation slows down, and much less heat can be removed from the body by evaporation. It is generally accepted that a relative humidity range from 45 percent to 50 percent relative humidity affords a desirable comfort level at a range temperature from 72° to 80° F.

Effects of Temperature and Air Circulation

Both the amount of moisture in the air and the amount of air circulation affect the rate of evaporation. Warm air slows down the rate of evaporation and cool air increases it. Interaction of temperature and humidity has a great deal to do with body comfort.

When circulation is poor, evaporation decreases greatly and, consequently, less heat can be removed from the body through evaporation. As air circulation improves, evaporation increases and the moisture in the air near the body is moved rapidly away from the body. Ceiling fans, which are popular energy-saving devices, provide an effective way to cool rooms because they create air circulation.

Latent Heat

The basis for air conditioning and refrigeration involves the principle regarding the addition and removal of heat energy. Heat that cannot be felt or recorded on a thermometer is called **LATENT HEAT**. Each substance has two forms of latent heat. One is liquid-to-gas heat, which involves vaporizing and condensing. The other is solid-to-liquid heat, which involves melting and freezing. The heat required to change a substance from solid to liquid is called the **LATENT HEAT OF MELTING OR FUSION**. The term used for changing a liquid to a gas or vapor is the **LATENT HEAT OF VAPORIZATION**.

Sensible Heat

When a measurable change occurs in the temperature of a substance, the heat responsible for the change is called **SENSIBLE HEAT**. You were shown earlier that sensible heat can be measured with a thermometer to determine how much the temperature has risen or fallen. When heat is removed from a substance, as it is by the air-conditioning and refrigeration process, the amount of heat removed is sensible heat. Understanding the terms latent heat and sensible heat is important in understanding the more advanced principle of the compression refrigeration cycle.

Body Comfort

To maintain body comfort, your surroundings must allow your body to remove heat through evaporation, radiation, and convection. You have already been shown how evaporation removes heat. The two processes of **RADIATION** and **CONVECTION** are also in operation while evaporation takes place.

Moving from a shaded area into the sun, you feel the effect of the radiation of the sun. Heat rays move heat from a source of heat like your body, which has been warmed by the sun, to other matter. This process is called **RADIATION**.

The convection process is also at work, along with evaporation and radiation, in helping to remove body heat. The air near the body has a lower temperature than the body and absorbs body heat. This air becomes warmer and moves upward. Warm, lighter air always moves upward, while cold, heavier air moves downward. The action of this warmer air moving upward allows heat that is not quite as warm to replace it. This entire process that has now been completed is called the **CONVECTION CYCLE**. By convection, heat will always flow from a hot surface to a surface containing less heat.

An adequate amount of **AIR CIRCULATION** is needed for body heat to be removed effectively through evaporation. As air movement around the body increases, both convection and radiation operate at a faster rate to remove heat. The three heat-removing processes of evaporation, radiation, and convection, shown in figure 1, are all improved by good air circulation.

Specific Heat

Another type of heat that must be considered in air-conditioning is **SPECIFIC HEAT**. The specific heat of what is being cooled affects an air-conditioning system. Building materials have different values of specific heat. A particular value of specific heat must be assigned to each substance. These values are represented by the number of Btu required to raise the temperature of one pound of the substance by 1° F. Water has a specific heat of one. In figure 2, the comparison of two equal containers of water, each weighing one pound, is used to illustrate this. The temperature of the container on the right has been raised one degree by the addition of one Btu. However, 10 Btu would raise the temperature of 10 pounds of water only one degree as well. Weight and mass should always be taken into account. Done properly, this allows you to determine how much heat should be removed from an area to provide a desirable level of comfort. When several people are present in a room, more heat must be removed than when only one is present. Charts giving specific values of substances used in building materials are available from the construction industry. When the value of specific heat is known, it can be used to determine the amount of heat that must be moved to heat or cool a substance.

The ability of air in a building to hold moisture increases when it is heated. Central air-conditioning and heating systems may be heated by electricity, hot water, or heat pumps. Whatever method is used, the result is the same. Relative humidity that is too low or too high in an indoor area can cause or aggravate many health problems.

Cold air retains little moisture. Earlier you were shown that **RELATIVE HUMIDITY** is the percentage of moisture in the air compared to its maximum ability to hold moisture. The indoor relative humidity recommended is from 35 percent to 45 percent. At a natural temperature of 70° F the air in a room can hold much more moisture (about twelve times the amount as at 10° F) than it can hold at a lower temperature. When air is heated to normal room temperature, relative humidity drops considerably.

Humidifiers

The function of a **HUMIDIFIER** is to add moisture to the air. Some rooms may become so dry that it is necessary to add a humidifier. If such a problem exists in an entire building, a power humidifier can be installed on the warm-air plenum of forced-air furnaces. The calibrated dial of a humidistat, which controls the humidifier, can be set to attain the desired humidity. Humidifiers are usually placed in a main living area of a building.

The main parts of a humidifier are shown in figure 3. A water supply delivers water to the distribution pan. The water flows down onto the evaporator and to the drain. The dry air enters from the right and passes through the damp evaporator panel to exit at the right side as humidified air.

Dehumidifiers

Excessive humidity is a problem in many areas of the country. In coastal areas, for example, it is so humid that clothing in closets becomes damp and may mildew. A **dehumidifier** is used to remove the troublesome excess moisture from the air.

The dehumidifying process is illustrated in figure 4. Humid air is drawn in to the left and passed through the condenser coils. Some of the moisture is removed and runs down the condenser coils to the drain. The drier air is forced through the other side by a fan. Some units also filter the air before it is returned into the room. A humidistat control is also provided on the dehumidifier. A larger dehumidifier may remove as much as 30 pints of water in a day. Smaller units remove about 14 pints a day.

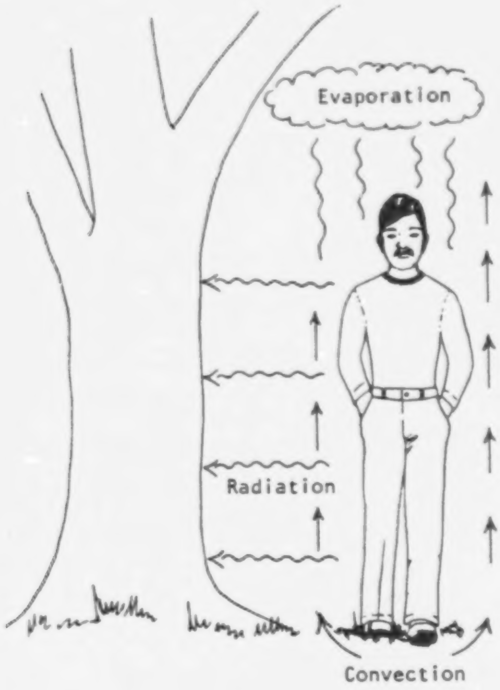


Figure 1. Heat-removing processes

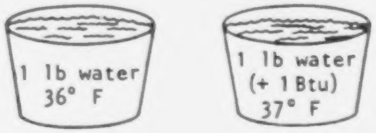


Figure 2. At sea level one Btu raises the temperature of one pound of water 1 °F

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ **DATE**__________

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: Effects of Atmospheric Conditions on Air Conditioners

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will become familiar with the effects of atmospheric conditions upon air conditioners.

REFERENCE: Student Information Sheet/Effects of Atmospheric Conditions on Air Conditioners

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What is humidity?

2. What is meant by the term **RELATIVE HUMIDITY**?

3. How does air circulation affect the evaporation process?

4. What are the terms used for two different types of latent heat?

5. What is the heat that is required to change a substance from a solid to a liquid?

6. What is the heat required to change a liquid to a gas or vapor called?

7. What three processes help remove body heat?

8. How does evaporation remove heat from the body?

9. How does radiation remove heat?

10. How does convection remove heat?

11. What causes relative humidity to drop in a room?

12. What is the function of a humidifier?

13. What can be set to attain the humidity that is desired?

14. How does water cycle through a humidifier?

15. How much water may be removed per day by a large dehumidifier?

16. What type of air retains little moisture?

17. How is moisture removed through the use of a dehumidifier?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: How Does the Compression System Operate?

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to demonstrate an understanding of the operation of a compression system.

A pressure difference must exist in a refrigeration system for the refrigerant to move through the components of the system in a complete cycle. The **compressor** is the component responsible for creating the pressure difference between the high-pressure side and the low-pressure side of the system. The movement of refrigerant is always from high-pressure locations to lower-pressure locations in the system. An electric motor provides the mechanical energy to operate the compressor. In the most commonly used compressor design, the motor is sealed in together with the compressor parts as one unit.

The compressor has been compared to a gasoline engine, because it has many of the same parts. Some of the parts also found in a gasoline engine are cylinders, pistons, piston pins, piston rings, connecting rods, crankshafts, and valves (see figure 1). The three types that have proven most successful for modern compressor applications are the **rotary,** the **centrifugal**, and the **reciprocating compressor**.

The centrifugal compressor is used for large industrial applications only. The rotary compressor is produced in small, compact sizes, for use in family-size refrigerators, but not in heavy commercial refrigeration units. The most commonly used of the three types is the reciprocating compressor, which is rugged in construction and easy to maintain.

Reciprocating Compressors

The two basic types of reciprocating compressors are the **OPEN** type and the **HERMETICALLY** sealed type. Each has its advantages and disadvantages, but more of the hermetically sealed units are in use today, because they are smaller and more compact.

An open compressor, driven by an external motor, is more flexible than the hermetically sealed compressor. It can be used with different sizes of motors and for various temperature applications. Since the motor is external to the unit, it is also much easier to replace a motor on an open compressor. When the motor in a hermetically sealed unit is damaged, the entire compressor must be replaced. Since the motor is sealed in with the compressor, in a hermetic unit, the entire unit must be at least reconditioned before it can be put back into service.

Despite the many advantages of open compressors, hermetically sealed units are more popular because they are not only compact and durable, but efficient in operation as well. Much of the improvement in the energy efficiency of modern cooling systems has been made possible through the use of these small, compact, hermetically sealed compressors.

Suction and Discharge Valves

The design of a compressor must include a device that will open or close at the proper times to allow the intake of refrigerant at one point and the discharge of refrigerant at another point. This device is called a **valve**. Two valves are used in a compressor--the **suction valve** and the **exhaust valve** (see figure 1). The suction valve allows low-pressure refrigerant vapor from the evaporator coil to enter the compressor. The exhaust valve allows high-pressure gas to leave the compressor and move on to the condenser coil. The location of these valves will vary according to the design of the manufacturer.

Compression-Cylinder Parts

The pumping action of the compressor is provided by a **PISTON**, which moves back and forth in the cylinder. The piston is closed at one end so it can create the needed pressure while it moves through the cylinder. The other end of the piston is open, and is attached by a wrist pin to the **CONNECTING ROD**. The connecting rod is attached to the **crankshaft**.

Modern compressor pistons have included piston rings to provide proper lubrication and to seal the cylinder walls. A piston should fit its cylinder wall snugly so that it will not drop in of its own weight. However, you should be able to push it through the cylinder with a slight tap of your finger.

The type and size of compressor chosen for an air-conditioning system depend both on the cooling and freezing applications. Systems may be used with any of the three types of compressors.

Energy-Efficient Compressors

No cooling system component is more critical to efficiency than the compressor. Modern two-speed hermetically sealed compressors enhance a cooling unit's energy efficiency. Indoor thermostatic switches allow you to monitor compression operation from inside the building. Some thermostats have different colored pilot lights to show which stage the compressor is in. One color indicates it is in low speed for money-saving efficiency. When the compressor shifts to a higher speed to ensure proper cooling, a light of another color comes on.

The big advantage of the two-speed compressor over the old one-speed compressor is that it saves energy by running at low speed when the cooling demands are only light-to-medium.

Another advantage of energy-efficient two-speed compressors is that since they are more effective at dehumidifying a house than single-speed units, the occupants are able to remain cool and dry with the thermostat at a higher setting. The higher the thermostat is set, the lower the electric bill should be.

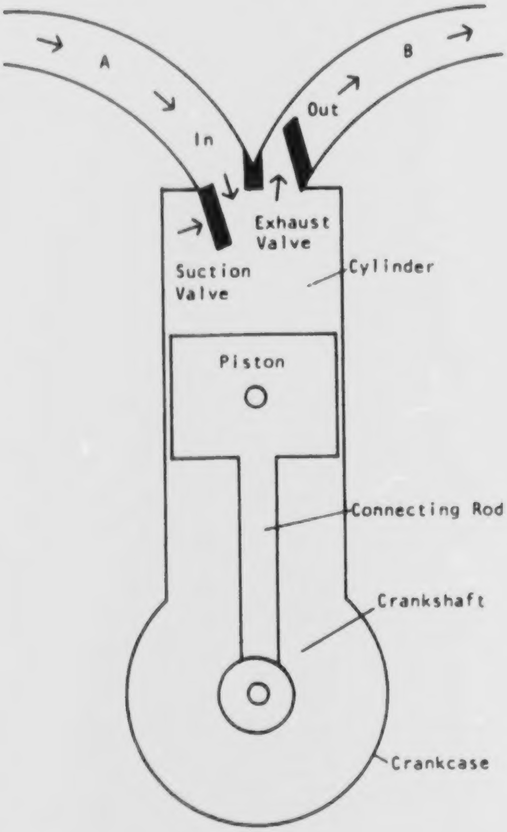


Figure 1. Basic parts of a compressor

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: How does the Compression System Operate?

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of the operation of the compression system.

REFERENCE: Student Information Sheet/How Does the Compression System Operate?

DIRECTIONS: Read and answer each question in the space provided.

1. How does the pressure difference in a refrigeration system cause the refrigerant to move through the system?

2. What are three types of refrigerant compressors?

3. Why are hermetically sealed compressors so popular?

4. What is the function of the suction valve in a compressor?

5. What is the function of the discharge valve in a compressor?

6. What are two advantages of using energy efficient two-speed compressors?

7. What compressor is used for large industrial applications only?

8. What should be done when the motor of a hermetically sealed unit is damaged?

9. What does the type and size of a compressor chosen for an air-conditioning system depend on?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT:	Fundamentals of Air Conditioning and Refrigeration
TOPIC:	How Do Electric Motors Operate?
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be familiar with the operation of electric motors.

Refrigerated central air-conditioning units employ fractional-horsepower electric motors in several locations, in both inside and outside units. At least three small fractional-horsepower motors can be found in the average residential central air conditioning system. Window-mounted air conditioners can contain the same number of motors in one unit. However, window-mounted room air conditioners often use one motor to operate the evaporator fan and the condenser fan at the same time. If so, the room air conditioner unit would use only two motors. The other motor would be inside the hermetically sealed compressor.

A central air conditioning unit must have a blower-fan motor to provide inside air circulation. This fractional-horsepower motor is inside, in the plenum chamber (chamber for moving air). The other two motors are located outside the dwelling at the condenser unit. One motor is used as a fan motor to blow air through the condenser coils to dispel heat. The other motor is inside the hermetically sealed compressor.

Since fractional-horsepower motors used in refrigerators must operate under the most adverse conditions, the life expectancy of a refrigerator compressor motor is about five years, which is the length of the warranty on most refrigerators.

Principles of Motor Operation

You read earlier about electromagnetic induction. The principles of magnetism and electromagnetism are basic to the operation of all electric motors. The use of alternating current (AC) has been adopted for electrical distribution systems in the United States because it is more practical and less expensive than direct current (DC). For this reason, AC motors are used on air conditioning and refrigeration equipment. These motors operate on 60 Hertz (H_z, cycles per sec.) AC current.

A two-pole motor is shown in figure 1A to illustrate the basic principles of electric motor operation. A bar magnet is placed on a shaft so that it can rotate inside the magnetic fields of two magnetic poles. The outer two magnetic poles are called the **STATOR**; the inside rotating component is called the **ROTOR**. By repulsion and attraction of magnetic poles, the rotor begins to turn in the direction shown in figure 1A by the arrows. After turning one-half revolution it will stop in the position shown in figure 1B. At this point no further rotation would occur because the unlike poles attract each other except, just at this instant, the 60-cycle current changes direction. The stator pole on the left changes to a north pole, as shown in figure 1C, and the change in polarity of the stator poles causes the rotor to turn another one-half revolution due to repulsion and attraction of poles. The rotor ends up in the position shown in figure 1D. When the current changes again, the rotation of the rotor continues. The motor will continue to rotate until the current is switched off.

The speed and efficiency of a motor can be increased by increasing the number of poles. An AC motor with a four-pole stator is shown in figure 2. This motor is a basic induction motor with a rotor and a four-pole stator. One wire is wound around the four poles to create the four-pole electromagnetic field. The rotor is made of mild steel with an insulated coil wrapped around it. Remember, for induction to take place, the stator and rotor do not need to be connected. The current in the stator creates a current in the rotor by electromagnetic induction. The AC power source is connected to the stator. You were shown earlier how 60 cycle AC current changes direction 120 times per second. The same principle that applied to the two-pole motor applies to motors with any number of poles, as long as they are even numbered.

Induction Motor

The most simplified form of electric motor is the type commonly used to operate electric fans--the **INDUCTION MOTOR**, which runs completely by induction. The rotor in an induction motor resembles a squirrel cage and is often referred to as a **SQUIRREL-CAGE** rotor. Hermetically sealed **compressor motors** are induction motors whose stators have two field windings. One winding is a **STARTING WINDING** and the other one is a **RUNNING WINDING**. An external relay disconnects the starting winding after the initial starting torque has been reached, and the running winding takes over from there on until the motor is switched off.

Repulsion-Induction Motor

A motor that has long been used in the refrigeration field is the **REPULSION-INDUCTION MOTOR**. This motor, like most other motors, is a form of an induction motor. It starts by repulsion and attraction of poles, but runs by electromagnetic induction. A single field winding is used, as in the basic motor shown in figure 2. Another term used for rotor is **ARMATURE**. The inside rotating part of the repulsion-induction motor is called an **armature**, because it uses a wire-wound armature instead of the squirrel-cage rotor the induction motor uses.

Capacitor-Induction Motor

A capacitor in the start winding of an induction motor can be used successfully for many applications. Called a **CAPACITOR-INDUCTION MOTOR**, it may also be referred to as just a capacitor motor, or a capacitor-start motor. This type motor has almost replaced the repulsion-induction motor for use in air-conditioning and refrigeration equipment. The capacitor is usually mounted on or near the outside motor case, which makes it easy to reach without disassembling the motor.

Capacitor-start motors have two different stator windings. The smaller-gauge winding is the starting winding. The running winding can be identified easily as the larger-gauge, more durable winding. A squirrel-cage rotor with a centrifugal switch mounted on it is used . When the motor is not running the centrifugal switch is in the closed (on) position. This switch is used to allow the capacitor to give a starting boost to the motor in the starting circuit. When the speed of the motor reaches 1,725 to 1,800 revolutions per minute (rpm) the centrifugal pressure is enough to force the switch to the open (off) position. This switching action turns off the starting circuit and current moves only through the running winding. Remember that when the motor first starts, and before the speed reaches 1,725 rpm, the centrifugal switch is closed, putting only the starting winding in the stator circuit. Current then flows only through the starting winding, thus allowing the capacitor to give an extra boost.

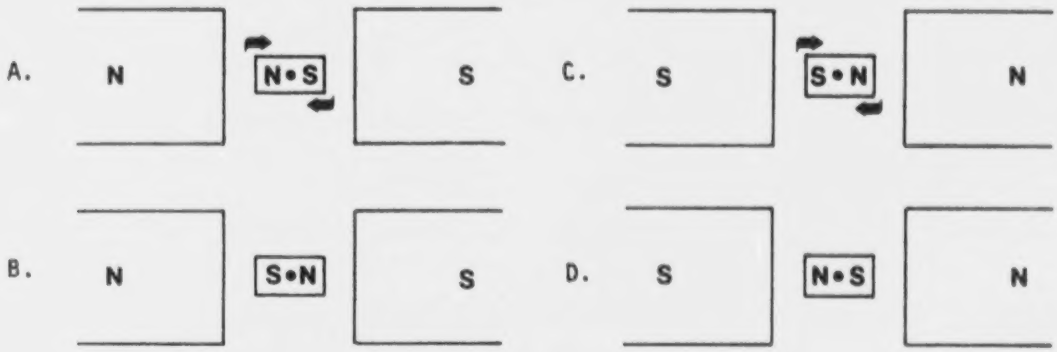


Figure 1. Basic two-pole motor

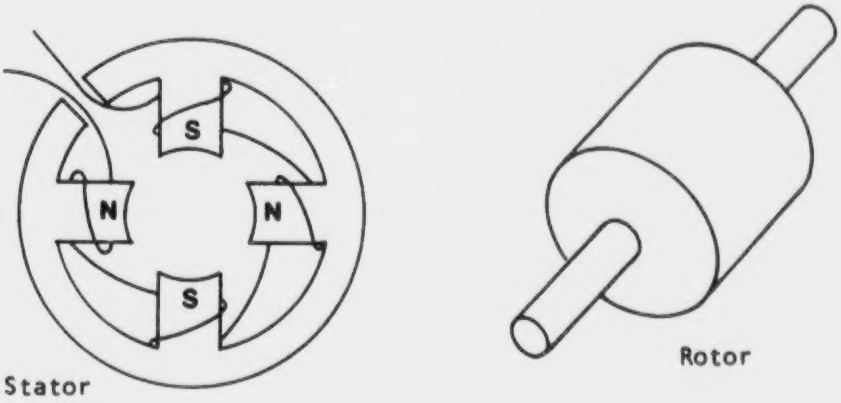


Figure 2. Simple induction motor

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: How Do Electric Motors Operate?

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will become familiar with the operation of electric motors.

REFERENCE: Student Information Sheet/How Do Electric Motors Operate?

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. How does a two-pole motor operate?

2. What is the simplest form of AC motor used in refrigeration systems?

3. What are the basic parts of an induction motor?

4. How does the repulsion-induction motor operate?

5. What are the parts of a capacitor-start motor?

6. What is the function of each part of a capacitor-start motor?

7. How can the speed and efficiency of a motor be increased?

8. Name the two windings found on hermetically sealed compressor motors.

9. What is another name for a rotor?

10. What type of switch is mounted on a squirrel-cage rotor?

11. Why is the inside rotating part of a repulsion-induction motor called an armature?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: How Do Electrical Controls Operate?

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be familiar with the operation of electrical controls.

Any time electrical equipment fails to function properly, the equipment itself may be damaged, or the individuals using it may be harmed. Therefore, when electrical circuits are designed, the manufacturer must include motor control devices to ensure that motors operate in the safest and most efficient manner possible.

Switching Devices

Manual motor controls must be used for some air conditioning and refrigeration equipment. For example, a fan, or pump motor with continuous operation may have a push-button or toggle switch. When such switches must be replaced, use an identical replacement part from the manufacturer.

Overload cutouts are included in these basic starting circuits. The protective cutouts are placed in the main motor windings, in the form of heaters to open the circuit contacts and thus save the motor. These devices protect the switches as well as the motor.

Motor Protectors

It is important, for reasons of both safety and economy, to provide some sort of motor protector in air-conditioning equipment. One motor protector, a **BIMETALLIC PROTECTOR**, operates on the same principle as the bimetallic-strip switch used in thermostats. Bimetallic protectors are often placed on motor windings in series with the windings, where they act as circuit breakers. The contact points open and break the circuit before the winding burns out. Thermistors are also used in circuits to provide protection from thermal overload. Thermal protectors are used for single phase motors under 5 HP.

When an internal component like a motor winding burns out, it is usually more practical, and less expensive in the long run, to replace the entire motor rather than to repair it. In most cases, a replacement motor must have exactly the same specifications as the original motor.

Relays

It is an advantage to be able to switch high-voltage equipment on and off, using a safer low-voltage circuit. The device used to accomplish this is a magnetic switch called a **RELAY**. A relay switch is often used as a **REMOTE-CONTROL** switch. A low-voltage, low-current circuit can be placed in a central air-conditioner in an inside position. A higher-voltage circuit is located in the outside condenser unit. The magnetic relay switch that controls the operation of the compressor and condenser fan motor can be switched on and off from the unit inside the building. This arrangement is shown in figure 1. All inside controls are on the harmless low-voltage circuit.

The use of relays can also dispense with the need to run heavy wires to the control switch. When high-current devices are controlled by low-voltage, low-current circuits in a remote location, a much lighter gauge of wire can be used. A great deal of heavy-gauge wire is saved by the arrangement mentioned above, with the low-voltage inside control running to a relay which controls the higher voltage circuit in the outside condenser unit.

The relay switch used in most air-conditioning equipment has several switching contacts that are activated at the same time. These relays should be constructed for heavy-duty service with contact points made of silver, silver alloy, tungsten, or some other durable alloy. Relays are designed to either open or close a circuit. The at-rest position of a relay is designated as **NORMALLY OPEN** or **NORMALLY CLOSED.** The coil used in a circuit must produce a magnetic field at the rated voltage sufficient to operate the switch contact points efficiently.

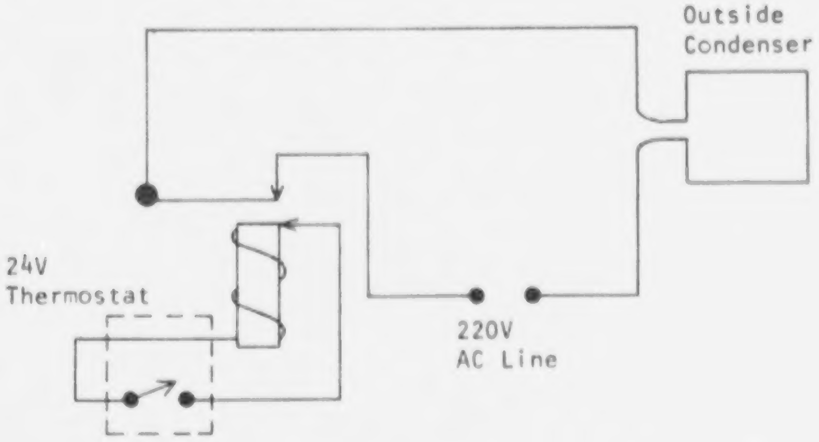


Figure 1. Magnetic relay switch

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ **DATE**_________

UNIT:	Fundamentals of Air Conditioning and Refrigeration
TOPIC:	How Do Electrical Controls Operate?
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will become familiar with the operation of electrical controls.
REFERENCE:	Student Information Sheet/How Do Electrical Controls Operate?
DIRECTIONS:	Read and answer each of the following questions in the space provided.

1. What is the main purpose of motor control devices?

2. What is the purpose of overload cutouts in basic starting circuits?

3. When is it usually more practical and less expensive to replace, rather than repair a motor?

4. Why are bimetallic protectors used for motors?

5. What is used to switch high-voltage equipment on and off using a safer low-voltage circuit?

6. When are thermal protectors used?

7. How are relays at rest position designated?

8. What must a coil used in a circuit produce?

STUDENT INFORMATION SHEET

AIR CONDITIONING AND REFRIGERATION

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: Air Conditioning Requirements for Ventilation

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. explain how the pressure system in a central air-conditioning unit causes the air to circulate through a complete cycle;
2. tell why modern buildings should have a controlled fresh-air intake; and
3. tell what considerations should be taken into account regarding the location of outlets from an air duct system.

You were shown earlier that a refrigerant moves through a refrigeration system from the high-pressure valve of the compressor to the low-pressure intake valve of the compressor. In a complete cycle, the movement is from high pressure to low pressure. Heat flows in a similar manner from points of higher temperature to points of lower temperature.

The natural movement of air can also be explained by accounting for differences in **AIR PRESSURE**. Air flows from a **HIGH-PRESSURE** area to an area of **LOWER PRESSURE**. In a central air-conditioning system the blower, shown in figure 1, is placed in a central access panel. The blower is the air pump for the air-circulation system.

The entire air-circulation system is shown in figure 2. The blower unit is shown in the central air plenum, with ducts leading to and from the living area. Air flows from the blower at A into the discharge air plenum where the high-pressure air moves through the air **DUCT** to enter the normal room atmosphere at B. Any air passage through which air flows to living areas is called a duct. The atmosphere of the living areas is at a lower pressure than the pressure at A, so the natural movement is from A to B. The air moves from the normal atmospheric pressure in the living areas through the return air duct and back to the other side of the blower. The natural air flow is in this direction because of the low pressure created by the blower. The blower motor turns the fan blades in a counterclockwise direction which forces a great deal of air into the discharge air plenum, compressing the air and creating the highest air-pressure area. The depletion of air in the return air plenum moves back into the blower access panel to complete the cycle again. It will be recycled again through the blower and into the discharge air duct. The air movement continues in the same manner as long as the blower motor is running.

Most blower fans can be set for two or three speeds. The higher the speed of the blower fan, the higher the pressure difference in the system. This means that when the fan is switched to a higher speed, the air movement throughout the entire cycle is speeded up.

Ventilation

Fresh air is a basic requirement of life. If all the living space in a dwelling were perfectly sealed in from the outside air, the people inside could live only as long as it would take to consume all of the oxygen. Fresh air contains about 21 percent oxygen. To keep replenishing the oxygen in an air-circulation system, a certain amount of fresh air is necessary. Some sort of ventilation is needed to do this because people cannot survive with insufficient oxygen.

In the past, air leakage through cracks in a building allowed enough fresh air to enter to meet normal ventilation requirements, but the construction of modern buildings permits little air leakage. This makes it necessary to add some device into the air system to supply fresh air. These modern units have added a **CONTROLLED FRESH-AIR INTAKE**. In some instances, when odor, smoke or pollen is a problem, an **AIR-CLEANING SYSTEM** may also be added. In a controlled fresh-air intake system, the fresh air is conditioned (heated or cooled) and mixed with the recirculated air before the fresh air reaches the living areas.

Drafts

Placement of outlets from air ducts must be made in a way that avoids objectionable drafts or excessive noise. For example, most people become uncomfortable if air moves through a living area at a rate faster than 25 feet per minute.

It has been estimated that, for a duct outlet to discharge air about 8 feet into a room, an air velocity of 500 feet per minute is necessary. The design of the ducts and outlets must restrict air velocity to 25 feet per minute or less in areas where people are likely to be. One method is to place outlets high above the heads of the occupants, which allows drafts to diffuse by reflecting against the walls and gradually fall to the level of the occupants.

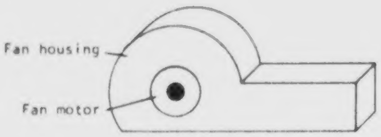


Figure 1. Blower unit

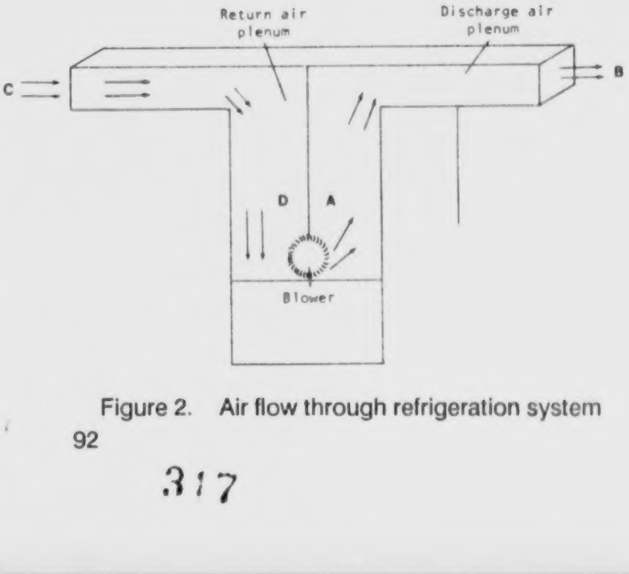


Figure 2. Air flow through refrigeration system

ASSIGNMENT SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Fundamentals of Air Conditioning and Refrigeration

TOPIC: Air Conditioning Requirements for Ventilation

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. explain how the pressure system in a central air-conditioning unit causes the air to circulate through a complete cycle;
2. tell why modern buildings should have a controlled fresh-air intake; and
3. tell what considerations should be taken into account regarding the location of outlets from an air duct system.

REFERENCE: Student Information Sheet/Air Conditioning Requirements for Ventilation

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. How does air flow?

2. What is the definition for a duct?

3. In what direction does the blower motor turn the fan blades?

4. What happens when the speed of the blower fan is increased?

5. What happens in a controlled fresh-air intake system?

6. What is the speed of air movement at which people become uncomfortable?

7. How is air velocity usually restricted?

8. What is an advantage of having outlets high above the heads of the occupants?

9. What should be done when an odor, smoke, or pollen problem exists in the space to be cooled?

JOB SHEET

AIR CONDITIONING AND REFRIGERATION

NAME______________________________ **DATE**__________

UNIT: Working in Air Conditioning and Refrigeration

NAME OF JOB: Cleaning Condenser Coils

UNIT: OBJECTIVE: After completion of this unit, the student will be able to perform minor service and maintenance in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to clean condenser coils on an air conditioner.

TOOLS AND EQUIPMENT: Water/garden hose, stiff bristled broom, bucket, portable air tank, condenser coils,and safety glasses

MATERIALS: Soap and water

GENERAL INSTRUCTIONS: One of the first things checked on a pre-season cooling system checkup is the condition of the condenser coils. The outside condenser coils should be free of leaves and other debris. Water from a garden hose can be used on the coils. Always direct the spray from the side opposite the normal airflow through the condenser coils. Water pressure is usually all that is needed to dislodge debris that has blown into the fins. You must be careful not to damage thin metal fins that surround the coils. A stiff bristled broom can be used to loosen most lodged particles. Do not use a screwdriver. If the condenser is unusually dirty you may have to bring in a portable air tank. High air pressure can be used, but be very careful with it. A small cut, when hit by a blast of high-pressure air, can rupture the blood vessels, which can be fatal. Work with the air-pressure hose from the same direction as with a water hose. Remember to wear safety glasses, or a mask, for protection in case dust or dirt blows back into your face. A strong solution of soap and water can also be used, but be careful not to get any electrical parts wet.

PROCEDURES AND/OR TASKS:

1. Using the garden hose, spray the condenser coils from the opposite side of the air flow. If needed, proceed to step 2.
2. Use the stiff bristled broom to loosen lodged particles from the condenser coils. If needed, proceed to step 3.
3. If the condenser is unusually dirty, use high air pressure from the portable air tank. Work with the air-pressure hose from the same direction as with a garden hose. If needed, proceed to step 4.
   CAUTION: Be careful to keep the air pressure hose pointed away from yourself and others to avoid injury.
4. If the condenser coils are still dirty, mix a soap and water solution in the bucket. Apply the soap and water to the coils with the stiff bristled broom. Rinse with water sprayed from the garden hose.
   CAUTION: Be careful not to get any electrical parts wet.
5. Replace equipment and materials used and clean work area.

JOB SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____**DATE**__________

UNIT: Working in Air Conditioning and Refrigeration

TOPIC: Replacing the Air Filter

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor service and maintenance in air conditioning and refrigeration.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to correctly replace the air filter in an air conditioning system.

MATERIALS: Air filter

GENERAL INSTRUCTIONS: In the past, not all air conditioners were equipped with air filters, but most units have them today. Air filters are included in the design of a unit not only to remove dust from the air, but also to offer some resistance. It is important to recognize a unit designed to use a filter and to be certain the filter is in place before turning the unit on, because running an air conditioner without its filter can cause damage to the system.

PROCEDURES AND/OR TASKS:

1. Read the instructions on the air conditioning unit concerning type and size of air filter to be used.

2. Following the instructions on the unit, remove the old air filter.

3. Select the proper replacement air filter.

4. Correctly install the new air filter.

NOTE: Have your instructor check your work.

JOB SHEET

AIR CONDITIONING AND REFRIGERATION

NAME____ **DATE**__________

UNIT:	Working in Air Conditioning and Refrigeration
TOPIC:	Lubricating the Components of an Air Conditioning System
UNIT OBJECTIVE:	After completion of this unit, the student will be able to perform minor service and maintenance in air conditioning and refrigeration.
SPECIFIC OBJECTIVE(S):	In completing this job sheet, the student will demonstrate the ability to correctly lubricate the components of an air conditioning system.
TOOLS AND EQUIPMENT:	Small oil can
MATERIALS:	Rags, SAE 30-weight oil
GENERAL INSTRUCTIONS:	For air conditioning equipment to function properly, it is necessary to perform certain preventive maintenance. Adequate cleaning and lubrication of the components of the system is most important to ensure proper operation. For example, all motors that do not have sealed-in bearings have small oil cups or holes for oil, which should receive two drops of SAE 30-weight oil at the beginning of the cooling season every year. Homeowners who call in an air-conditioning mechanic every year for a pre-season checkup will usually save money in the long run. They will avoid costly repairs or replacements that would have been necessary if preventive maintenance had not been performed.
PROCEDURES AND/OR TASKS:	1. Check to see if the system has sealed-in bearings in motors. If the system is not sealed, move to step 2. 2. Identify the oil cups or holes for oil in each motor. 3. Place two drops of SAE-30 weight oil in each oil cup or hole. 4. Carefully wipe up any oil you may have dripped. 5. Return oil can and oil to the proper storage area. 6. Place rag in the proper container.

SECTION II

BRICKLAYING/STONE MASONRY

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Safety

TOPIC: General Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. list general requirements for good housekeeping;
2. discuss personal protective devices to use in masonry trades; and
3. describe safety measures to use when using ladders and scaffolds.

Good Housekeeping

Good housekeeping on a job means the orderly placement and storage of tools and materials. Housekeeping rules also serve as safety measures because loose articles and litter may cause you or another worker to stumble or fall and suffer an injury. Common sense can prevent accidents as well as damage to materials and equipment.

Always keep the work space clear and safe for all persons in the area. Place tools and materials where they cannot fall. Where material must be stacked, make the stack neat and compact. Never leave tools or materials where they could be jarred loose. Also, never leave them against a wall or other support that could collapse under the additional weight.

Personal Protective Devices

Whether you are working with brick or stone, there are hazards that can be avoided by wearing protective clothing or devices.

Inhalation and skin exposure. Masons work with acid when cleaning brick and stone. This presents a potential threat to the health of workers. All organic solvents have some effect on the central nervous system and the skin. The principal types of exposure are vapor inhalation and skin contact. The inhalation of acid fumes may result in serious damage to the blood, lungs, kidneys, and gastrointestinal system. Skin contact may cause skin inflammation, ranging in severity from minor irritation to serious damage to the skin.

Dangers also exist when working in air contaminated with other dusts or fumes. Be sure that you have a National Institute for Occupational Safety and Health (NIOSH) approved respirator that is designed to protect against the specific hazards to which you will be exposed. Always clean the respirator at the end of each day's use. Replace defective parts and used filters. Never use another person's respirator unless it has been cleaned and disinfected. Be sure that the respirator has a good seal on the face. If you smell vapors during use, immediately check the seal, the filter, and the cartridge. Replace them if needed.

Noise exposure. Excessive noise is a common problem when working around power equipment such as a masonry saw. Noise can cause permanent hearing damage. Be sure that you are not exposed to noise levels in excess of the standards that have been set up by the NIOSH. The current standard is 90 decibels, A-weighted (dBA), for an eight-hour exposure. Even at this noise level, hearing damage can be expected in some people. You should periodically have your hearing checked. There are several types of ear protection devices, from ear muffs to ear plugs. Some are better than others, depending upon the type and frequency of the noise they are designed for and depending upon how well they fit the individual.

Eye protection. Eye protection is needed where there is a possibility of an eye injury from flying particles, chips, or caustic materials. You should wear goggles or face shields when using grinders, power drills, masonry saws, and other power equipment.

Protective clothing. When handling hazardous liquids or sharp materials, you should wear gloves. Rubber gloves should be worn when working with acids. They should be long enough to protect the forearms. Hard hats should be worn around most masonry jobs, since materials or tools could fall from walls or scaffolds. Hard-toed shoes should also be worn to protect the feet from falling objects.

Ladders and Scaffolds

Ladders are either fixed or portable. Portable ladders are the single-unit, stepladder, or extension type. Most ladders are either metal or wood, although some very expensive ones are made of fiberglass. They should be kept in good condition at all times and should be coated with suitable protective material. Wooden ladders should have a transparent coating so you can see any cracks or flaws that might develop. All ladders should be stored where they will not be exposed to the weather and where there is good ventilation. Metal ladders should not be used near energized electrical equipment. Never place portable ladders on boxes, barrels, or other unstable bases. Use a nonslip base instead.

When setting up long, straight, or extension ladders, brace the lower end of the ladder against something solid so that it cannot slide. Place the ladder at the correct angle with the wall. The base of the ladder should be one-fourth of its working length away from the wall or support. If the ladder is placed at too great an angle (with the base too far out), the stress can cause it to break or slip. If the base is too close to the wall, the lader may tip backward. Be sure that the ladder has a firm footing before you climb it.

Never climb higher than the step below the top of a stepladder. If you stand on the top, you may lose your balance. Go up and down a ladder carefully, always facing the ladder. Carry tools or other work materials in your clothing or attached to a belt. Never overreach or lean to the side of the ladder.

Never climb higher than the step below the top of a stepladder. If you stand on the top, you may lose your balance. Go up and down a ladder carefully, always facing the ladder. Carry tools or other work materials in your clothing or attached to a belt. Never overreach or lean to the side of the ladder.

Only standard scaffolds suitable to the work at hand should be used. Each scaffold should be maintained in a safe condition, and no scaffold should be altered or disturbed while in use. Structural members, supportive lines and tackles, and other scaffold equipment should be inspected daily.

Scaffolds should be kept free of tools, equipment, and materials not being used. Unstable objects, such as barrels, boxes, loose bricks, and building blocks, should not be used to support scaffold planks. Lines should be used for raising and lowering tools and materials that cannot be passed from hand to hand. No objects should be thrown or dropped from scaffolds. If part of a scaffold must be used for loading or supporting materials, it should have additional bracing and reinforcing in and around the area. Never overload a scaffold with masonry materials.

Work on scaffolds should stop during storms or high winds or when scaffolds are covered with ice or snow. When scaffolding is dismantled, it should be cleaned and made ready for reuse or storage. Damaged or unsafe scaffolding should never be stored, as it might be accidentally used.

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME______________________________________**DATE**__________________

UNIT: Safety

TOPIC: General Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. list general requirements for good housekeeping;
2. discuss personal protective devices to use in masonry trades; and
3. describe safety measures to use when using ladders and scaffolds.

REFERENCE: Student Information Sheet/General Safety

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What are the dangers of leaving tools or materials against walls or other supports?

2. What cleaning agent may cause a health threat to masonry workers?

3. What may inhalation of acid fumes cause?

4. What else should you avoid when working with acid?

5. What should be worn when working around dusts or fumes?

6. What should you check if you are wearing a protector against harmful inhalation but still smell the vapors?

7. What may cause hearing damage?

8. What does the type of hearing protection device used depend on?

9. When should eye protection devices be used?

10. What two types of eye protection devices may be worn?

11. What should be worn for protection from tools or materials that might fall from walls or scaffolds?

12. Why should wooden ladders be coated with transparent coating?

13. When should metal ladders not be used?

14. How far should the base of a straight or extension ladder be from the wall on which it is leaning?

15. What direction should you face when going up or down a ladder?

16. When should work be stopped on scaffolds?

JOB SHEET

BRICKLAYING/STONE MASONRY

NAME:______________________________ **DATE:**______________________

UNIT: Safety

NAME OF JOB: Using Eye Protection

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to select and use proper eye protection.

TOOLS AND EQUIPMENT: Display of personal protective equipment

MATERIALS: No materials are required

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Select the proper safety equipment needed for eye protection.
2. Demonstrate how the equipment should be worn.
3. Clean the equipment.
4. Replace the equipment.

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Safety

TOPIC: Handling and Storage of Materials

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. explain the precautions to take when handling materials by hand;
2. list the steps for proper lifting; and
3. discuss the methods of storing tools and materials.

Handling Materials by Hand

Surveys indicate that a majority of industrial accidents occur while materials are being handled. Handling materials by hand seems to produce more accidents than handling materials by mechanical equipment. The damage and injuries, however, are not as severe. Nevertheless, people, not mechanical equipment, cause the majority of accidents.

All workers who handle materials should wear approved safety shoes. Foot and leg guards should be worn when handling heavy or sharp material that is likely to cause damage if dropped.

Workers should wear gloves when carrying, lifting, or moving objects that are sharp, splintery, or hazardous to bare hands. Workers handling acids should wear suitable approved clothing. Rings should never be worn by anyone handling materials. Fingers caught between heavy objects may be bruised, but if rings are present, serious cuts or amputation may result.

Lifting Heavy Objects

In masonry work, lifting heavy weights is usually necessary. The following suggestions are made to preserve the health of masonry workers. See figure one for proper lifting position.

1. Check the weight of the load before lifting. Do not lift an excessively heavy load. Get help if necessary.
2. In general, lift loads no heavier than about 35 percent of the lifter's body weight.
3. Lift with the legs and not the back.
4. Keep feet close to the object being lifted, with one foot slightly closer than the other for better balance.
5. Stand with the feet approximately 8 to 12 inches apart.

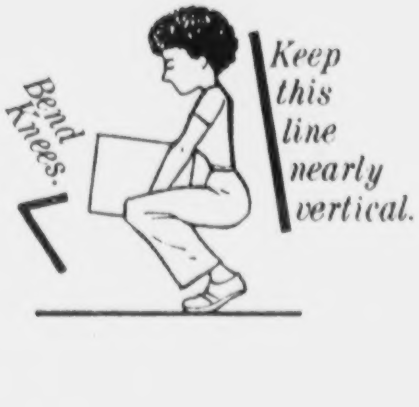
6. To lift something heavy, assume a squatting position with the back erect. Then raise the object by straightening the legs. This method will bring the leg muscles into use and take the strain off the back.

7. When two or more people are working together, lifting and lowering must be done at a given signal in order to equalize the load. The entire body should always be pushed upward with the legs. It is easier and safer.

Storing Materials

Piling and stacking should be done in a stable and secure manner so that materials may be easily reached or moved. Only authorized persons should be permitted in storage areas. Arrangements should be made for disposal of surplus or damaged materials and waste. Store acid in glass containers in low locations, such as on bottom shelves. This lessens the possibility of breakage from falls.

All hand and power tools should be stored in dry locations when they are not in use. If power equipment is left at the building site at night, it should be covered with rain-proof material. Mortar and other materials affected by moisture should also be covered.


Bend Knees.
Keep this line nearly vertical.

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME____ **DATE**____________________

UNIT: Safety

TOPIC: Handling and Storage of Materials

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. explain the precautions to take when handling materials by hand;
2. list the steps for proper lifting; and
3. discuss the methods of storing tools and materials.

REFERENCE: Student Information Sheet/Handling and Storage of Materials

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. When do a majority of industrial accidents happen?

2. When should foot and leg guards be worn?

3. What are used in hand-lifting operations?

4. When two or more people are working together, when must lifting and lowering be done?

5. Who should be permitted in storage areas?

6. When should gloves be worn?

7. What should never be worn by anyone handling materials?

8. What position would be assumed to lift a heavy load?

9. Where should acid be stored?

JOB SHEET

BRICKLAYING/STONE MASONRY

NAME:______________________________ **DATE:**______________________

UNIT: Safety

NAME OF JOB: Using Correct Lifting Procedures

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate correct lifting procedures.

TOOLS AND EQUIPMENT: No tools or equipment are required.

MATERIALS: Empty box

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Check the weight of the load.
2. Lift with your legs and not your back.
3. Keep feet close to the object being lifted, with one foot slightly closer than the other for better balance.
4. Stand with your feet approximately 8 to 12 inches apart.
5. Assume the squatting position with your back erect and then raise the object by straightening your legs.

   (**NOTE:** This method will bring the leg muscles into use and take the strain off the back.)

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT:	Safety
TOPIC:	Hand and Power Tool Safety
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to: 1. list precautions to take when using sharp-pointed hand tools; 2. discuss saw and blade safety; 3. describe safety to observe when using pounding tools; and 4. give safety rules concerning power equipment.

Hand Tools

Sharp-pointed tools. Although hand tools do not usually cause severe injuries, the greater number of industrial accidents occur during their use. Keep in mind that all cutting tools should be kept sharp, as forcing a dull cutting tool often causes accidents. Hand tools should not be carried on the person unless they are encased in a sheath or tool belt. Do not place these tools on surfaces where a worker could bump into them or knock them off.

Saws and chisels. These tools cause more accidents than most other hand tools. Chisels often have sharp cutting blades; therefore, touching them may cause a serious cut. Hand saws are sometimes used by the masonry worker. Always store saws and chisels with the blades down and cover all saw teeth when the tool is not in use. Use special care when sharpening saws and chisels.

Pounding tools. The mason may receive injuries in two ways when using pounding tools. Injury may result from missing a chisel head and hitting a finger or hand. Bruises, blood blisters, and torn flesh may occur from a hard, incorrectly placed blow. The hammer head should be flat, dry, and slightly rough to keep it from slipping off the chisel head.

Injury may also occur from pounding a chisel that has a mushroomed top, one that has been pounded until the top has spread and split around the edges. A hard blow may cause these metal particles to release and be thrown into the mason's face or eyes. See that the top of the chisel is ground off before hammering on it. Also, wear goggles or a face shield when doing this type of work to protect the eyes from flying rock or brick particles.

Masonry cutters. These cutters are very sharp and can cause serious injury or loss of fingers. Keep the fingers away from the blade during stone-splitting operations. Special care should be taken when removing, replacing, and sharpening these blades. Use leather gloves when possible.

Masonry saws. These saws are dangerous in several ways. The speed of the blade can cause materials to be thrown from the saw. Wear goggles or a face mask while sawing. A lot of dust is generated when cutting masonry materials, so it is also wise to use a respirator. Forcing the saw may cause the blade to break, so be sure guards are in place before making a cut. Use care when removing or replacing saw blades and take the usual precautions when sharpening a blade.

Cement mixers. Cement mixers are normally used to mix mortar for brick or stone. This device is often top-heavy when it is full and therefore should be on level ground and in a able position. If it tips over, the weight could cause a great amount of damage or injury. If large cement mixers are used, make sure that all troughs are in place during a "pour." Use loaded wheelbarrows with care, as a loaded wheelbarrow is hard to control on slopes or when trying to stop.

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME__________________________________**DATE**________________

UNIT: Safety

TOPIC: Hand and Power Tool Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. list precautions to take when using sharp-pointed hand tools;
2. discuss saw and blade safety;
3. describe safety to observe when using pounding tools; and
4. give safety rules concerning power equipment.

REFERENCE: Student Information Sheet/Hand and Power Tool Safety.

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. How should sharp-pointed tools be carried on the person?

2. Why should all cutting tools be kept sharp?

3. What two ways do injuries occur when using pounding tools?

4. In what condition should the hammer head be?

5. What should be worn when using pounding tools?

6. When should special care be taken around masonry cutters?

7. What should be worn other than a face mask or goggles when operating a masonry saw?

8. What care should be taken when mixing mortar?

9. Why should a loaded wheelbarrow be used with care?

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT:	Introduction to Careers in Bricklaying/Stone Masonry
TOPIC:	Careers in the Masonry Field
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to: 1. describe various types of jobs performed by bricklayers and stonemasons; 2. name locations where masonry workers normally find employment; 3. list the requirements for apprenticeship in the masonry trades;and 4. discuss the advantages and disadvantages of masonry as a trade.

Types of Work

Bricklayers and stonemasons (masons) work in closely related trades. Bricklayers construct walls, walks, patios, partitions, fireplaces, and other structures with brick, cinder block, and other masonry materials. They are also responsible for installing linings in industrial furnaces.

Like bricklayers, stonemasons also build walls, walks, and patios. However, they work with natural stone, such as limestone, granite, and marble. They also use artificial stone made from marble chips, cement, and other masonry materials. Stonework is usually found on large buildings, such as churches, hotels, and offices. Where stone is plentiful, it is also used on houses.

When erecting a wall, bricklayers first construct the corners or each end of the wall with a level and plumblines. A line is stretched from one corner to the other to be used as a guide for the first course or row of bricks. This line is moved upward for each succeeding course. Bricklayers spread a bed of mortar on the brick with a trowel. A brick is placed on the mortar and tapped into place; then excess mortar is raked off. Bricks are broken or cut with a hammer and chisel to fit windows, doors, and other openings. Mortar joints are finished with jointing tools to give a smooth and uniform appearance. Steel supports may be installed at window and door openings.

Hod carriers assist the bricklayers by keeping them supplied with bricks or other materials. They also mix mortar and set up and move scaffolding.

Masons must be able to read blueprints in order to understand the specifications of the particular job. The stonemason may use a set of drawings that includes numbered stones, so that each stone is placed in a specific location.

Stonemasons construct walls by setting the first course of stones into a shallow bed of mortar. Large stones may be placed through the use of hoists. The stones are aligned with plumblines and levels. A wooden mallet is used to tap them into place. Joints between the stones are filled with mortar using a trowel. Stonemasons often position pieces of metal within a wall to hold the stones in place. This metal may be welded or bolted together and then covered with mortar. Stones are cut with a special hammer or saw. Acid is used on the finished wall to remove dirt and dry mortar.

Masons also repair brick and stone walls by filling cracks with mortar or by removing and replacing damaged brick or stone.

Bricklayers and stonemasons mainly use hand tools such as trowels, brick and stone hammers, mallets, chisels, plumb bobs, levels, and measuring devices. Electric saws with masonry blades are often used for cutting. Wheelbarrows are often used to transport mortar to the working area.

Places of Employment

There are over 200,000 bricklayers and stonemasons, although most are bricklayers. Many bricklayers install stone as a sideline. Approximately 75 percent of these workers are employed by trade, building, or general contractors. The other 25 percent are self-employed. These masons do more small jobs, such as mailbox posts, walks, patios, and fireplaces.

Qualifications and Advancement

Most bricklayers and stonemasons attain their skill by working as helpers or hod carriers for experienced workers. Others learn their skill by participating in apprenticeship programs. These programs are usually sponsored by local contractors or union management committees. They require three years of on-the-job training and 144 hours of classroom instruction. Subjects covered are blueprint reading, layout and sketching, and mathematics. While working on the job, apprentices learn the procedures and methods for working with various masonry materials.

Applicants for an apprenticeship program must be at least 17 years old and in good physical condition. Hearing-impaired individuals should have no difficulty working in this trade. A high school or vocational school education is preferred. Helpful high school courses include mathematics, mechanical drawing, and shop. Workers may advance to supervisory or estimating positions, or they may begin their own masonry businesses.

Employment Outlook

Through the 1990s, employment of bricklayers is expected to grow more slowly than that of other industrial occupations. Some job openings will be due to experienced bricklayers' retiring, dying, or leaving the occupation. The number of openings will change from year to year as reflected by changes in the economy.

Employment of stonemasons will remain about the same during the 1990s. No increase is expected due to the rising cost of building with stone.

Earnings and Working Conditions

The average union wage for bricklayers is about $14.00 per hour, with stonemasons earning slightly more. Yearly earnings for workers in these trades are usually lower than the hourly wages reflect because of lost working days due to poor weather.

Beginning apprentices are usually paid about 50 per cent of the wage paid to experienced masons. A large percentage of bricklayers and stonemasons are members of the Bricklayers, Masons, and Plasterers' International Union of America.

Bricklayers and stonemasons usually work outside, so they are subject to extreme weather conditions. They sometimes have to stand, kneel, or stoop for long periods of time, and heavy lifting is necessary at times. They may be injured by hand tools, bricks, stones, and falls from scaffolds. However, although there are many hazards, masonry workers are less likely to be injured than other construction workers.

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME____ **DATE**____________________

UNIT: Introduction to Careers in Bricklaying/Stone Masonry

TOPIC: Careers in the Masonry Field

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. describe various types of jobs performed by bricklayers and stonemasons;
2. name locations where masonry workers normally find employment;
3. list the requirements for apprenticeship in the masonry trades;and
4. discuss the advantages and disadvantages of masonry as a trade.

REFERENCE: Student Information Sheet/Careers in the Masonry Field

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What do bricklayers construct?

2. What natural stones are used by stonemasons?

3. On what types of buildings is stonework usually found?

4. What does the bricklayer use as a bed for brick?

5. What type of repair work is done by masons?

6. Where are about 75 percent of the bricklayers employed?

7. What training is required in masonry apprenticeship programs?

8. How old must an applicant be for acceptance in the apprenticeship program?

9. What is the employment outlook for bricklayers in the 1990s?

10. What is the primary advantage of being a masonry worker as compared to other construction workers?

11. Name the disadvantages of working in the masonry trades.

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT:	Being Your Own Boss
TOPIC:	Setting Up a Masonry Business
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will: 1. recognize opportunities and options for business ownership; 2. identify entry-level procedures, planning processes, and terms needed to open a business; and 3. develop an understanding of the role of small business in the free enterprise system.

Types of Organizations

The owner of a masonry business can set up a business in several different ways. Sole ownership is the form used by most owners. The full responsibility for the company rests on one individual. No formal documents or agreements are necessary, and business and personal income may be the same for tax purposes.

A partnership agreement consists of individuals sharing responsibilities, liabilities, work, and profits. This agreement may combine the masonry experience of one person with the management abilities of another. A limited partnership usually consists of one person's supplying the capital and the other person's running the business.

A corporation involves more legal documents than a partnership, but it gives tax and liability advantages. Business and personal income taxes are separated, which allows for tax advantages. If losses occur in a corporation, the owner or owners are liable for only part of those losses. Capital can also come from stockholders. An attorney should be retained to draw up the necessary legal documents.

Taxes

The masonry contractor or owner must obtain an employer's identification (EI) number from the Internal Revenue Service. This number is used on forms submitted with social security and federal income taxes that have been withheld from employees' salaries.

Masonry contractors in states with sales tax laws must also submit these taxes periodically. Sales tax laws concerning the masonry trades vary from state to state.

The business must pay federal unemployment taxes if it has paid wages of $1,500 or more in any calendar quarter (three months) and if it has had one or more employees on the payroll at least some portion of one day in each of 20 or more calendar weeks. The basic tax rate is 3.2 percent of the first

$4,200 of taxable wages received by each employee. The actual rate to pay is much less because the federal government gives credit for unemployment taxes that are paid to the state government.

State government taxes are usually based on the taxable wage base of a quarter (three months). The rate of the tax charged is also usually determined by the employee's unemployment experience. In some states the worker is also assessed taxes through payroll deductions.

Some counties, towns, and cities impose other taxes. These include taxes on gross receipts of business and on unincorporated business taxes.

Insurance

A minimum amount of insurance must be carried by the masonry contractor or owner. This is designed to protect the workers and the owner from losses.

Worker's compensation covers liability if a worker is injured on the job. Some coverages also include driving to or from building sites.

Property insurance protects the contractor's property, materials, and equipment at either a central office or a building site.

Some masonry contractors furnish group insurance policies for their workers. The employer may pay for some or even all of the employee's insurance as a fringe benefit.

Contracts

No masonry construction should begin until a binding contract or agreement has been drawn up. This may be a contract with an owner of a house or building, a general contractor, or both. The contract should contain the price of the completed project, terms of payment, services, specifications, and time allowed for completion.

Financing the Business

Few masonry contractors can begin a business without acquiring additional capital. How much capital is needed depends on the type of masonry work to be done, the equipment that must be purchased, the number of employees that will be hired, the size and staff of an office, and the amount of money needed for the owner's living expenses.

Large jobs call for a large outlay of money, and loans are sometimes necessary at that time. The owner of a masonry business must build a good reputation for dependability so the risk to the lending institution is less.

The masonry contractor with sufficient capital can pay cash for materials and labor and avoid paying interest on borrowed money. Sometimes cash discounts are allowed on materials. With sufficient cash on hand, the contractor can invest in equipment to save time and money.

The lending institute usually asks for a complete financial statement from the contractor. It may also ask for a personal resume if it has not done business with the contractor before.

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Office

A large company must have an office or offices to keep up with all the necessary paperwork. Smaller contractors may work out of their homes. In this case, someone must always be near the phone to handle business calls. Many contractors now use the timesaving two-way radio or CB. The base unit is installed in the home or in the office. The contractor or other workers in the field make contacts through the base unit. Information is then relayed to other workers, the contractor, or to businesses that are supplying brick, stone, or other materials. This saves time-consuming trips.

Equipment and Materials

To be successful, the masonry contractor must spend a great deal of money for equipment. Although most workers will have their own hand tools, equipment such as hoists, scaffolds, cement mixers, wheelbarrows, stone-cutters, and so on are furnished by the masonry contractor. Some contractors haul their own brick or stone, which requires large trucks. The contractor should buy materials from businesses that are reliable in supplying the proper materials and making deliveries as promised. Late material deliveries can disrupt the entire building program.

Personnel

A good labor force is essential when the masonry business owner begins operation. The new contractor usually has friends who are good at their work and want to get in on "the ground floor" of a new business. Workers must be selected carefully. Starting a new business with unreliable or too few employees can mean instant failure. An understaffed office or too few workers on the job soon makes scheduling impossible.

Role in the Free Enterprise System

The United States is classified as a capitalistic nation. This means that businesses are operated under a free enterprise system. Free enterprise is based on the private ownership of businesses. Small businesses are important in the free enterprise system. While the free enterprise system allows goods to be produced or services to be performed for the purpose of making a profit, it is important that more than one business or source for these products or services be available. Competition between individually owned businesses not only allows the consumer to make a choice but also helps to insure quality of services and products and insures fairness in cost to consumers.

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

UNIT:	Being Your Own Boss
TOPIC:	Setting Up a Masonry Business
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.
SPECIFIC OBJECTIVE(S):	In completing this information sheet, the student will: 1. recognize opportunities and options for business ownership; 2. identify entry-level procedures, planning processes, and terms needed to open a business; and 3. develop an understanding of the role of small business in the free enterprise system.
REFERENCE:	Student Information Sheet/Setting Up a Masonry Business
DIRECTIONS:	Read and answer each of the following questions in the space provided.

1. What form of business ownership is used by most masonry owners?

2. What is a limited partnership?

3. Where does a masonry contractor or owner obtain an employer's identification number?

4. On what are state unemployment taxes usually based?

5. What does worker's compensation cover?

6. What are the advantages of the owner's having sufficient cash on hand?

7. What device is used to relay information to the contractor, office, or workers on the job?

8. What does an understaffed operation cause?

9. What should be done before masonry construction begins?

10. Why should the owner of a masonry business build a good reputation for dependability?

11. What may disrupt an entire building program?

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Being Your Own Boss

TOPIC: Human Relations in a Business

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. discuss factors involved in the selection of personnel;
2. explain how to effectively train new employees; and
3. discuss the effects of good human relations and morale upon an employee's production.

Selection of Personnel

A masonry contractor cannot afford to hire the wrong person for a particular job. The hiring must be done objectively, not emotionally. Just liking the applicant is not enough. Hiring must be based on the person's experience, attitude, and abilities that match the job.

First, the masonry contractor must be familiar with the duties and responsibilities of the position that is open. Most masonry contractors have at one time or another been involved in every phase of masonry work. This person usually knows how to operate all equipment and what steps to use when building with masonry. This makes it much easier to know how a certain individual can fill a specific position. It may help to have a complete description of the job to be filled.

When looking for new workers, a number of organizations can be helpful. State employment agencies, private employment agencies, recruiting firms, unions, and various social service organizations have leads on people wanting or needing jobs. The newspaper is often used to attract potential employees. Be as specific as possible with job requirements to avoid having to interview a great many unqualified people. One of the best ways to get new employees is through current employees. They can suggest names of people who are qualified and interested in working in masonry construction. If current employees are satisfied, they will be the best advertisement in attracting new employees.

The first step in evaluating potential employees is to check their backgrounds. An application form is the best source for some of that information. From this form it is possible to quickly determine if the applicant's education, training, and experience qualify the person for the position. For some jobs, it may be possible to train an individual to meet the standards of the job. Other jobs may require someone with many years of experience. For example, no contractor would hire an unskilled worker as a bricklayer. However,, that worker could supply mortar to a qualified bricklayer.

Employers should have some type of interview, whether formal or informal, with the applicant. This allows an opportunity to ask important questions about particular phases of the work. The applicant may also have questions, and it is better to answer them before the person is hired. Do not expect miracles during the interview. Because the applicant is trying to make a good impression, it may be hard to get a clear picture of the individual.

Keep several steps in mind during the selection process:

1. Analyze the position.
2. Determine what abilities the employee must have to fill the job.
3. Study personal factors, such as age, education, and health of the applicant.
4. Write a complete job description.
5. Interview objectively.
6. Check all references.
7. Compile and review all information before making a final selection.

Employee Training

When employees begin a new job, they should have an orientation period. During this time the job should be explained in full. Although the person may have the background experience for a particular job, it may include responsibilities unique to that position. Give the employee an overview of the company policies and rules.

Some employees must go through a training period. The length of time needed for this training depends on the job's responsibilities. For learning to take place during the training period, the employees must be able to learn at the level of the training program. The employees must also have the abilities and motivation needed to accomplish the job.

The trainers must organize their work to enable the new employees to learn. They must be patient and support the new workers during this learning period. The contractor or owner must support the training and give the trainer ample time to bring the new employees to the proper level of proficiency.

The training program should include information on safety. If employees learn safety from the beginning, they will form safety habits that may save time, expense, and suffering.

Be sure the trainers are competent. They must have the ability to communicate with others. Do not ask employees to train other people if they are opposed to the idea. They may only confuse the new worker. Ask other workers to support the training since they once had to go through it themselves. Check on the new employees periodically. Let them know that you are personally interested in their progress. Ask for suggestions that might make the training period easier.

Morale and Production

Good individual attitudes on the job lead to high group morale. When morale is poor, production always drops. It is very important for the contractor or owner to understand the viewpoints of the employees and recognize if an individual or group problem exists. If some employees tend to pick on another individual, put a stop to this immediately. This tends to affect not only that individual but also the company as a whole. Some employees are natural leaders. This means that they may lead other employees into bad situations as well as good. A leader who stirs up trouble can disrupt a complete project. These problems can be headed off before they become a source of poor morale. A good contractor does not allow employees to "side" against groups or individuals.

Many people leave high-paying jobs because of other factors which cause job dissatisfaction. Four primary factors that lead to good morale are:

1. satisfaction in the job itself;
2. pride in co-workers;
3. acceptance of pay policies and promotion opportunities; and
4. a feeling of belonging to the company.

High employee turnover, complaints, absenteeism, and low production are often indications of low morale. If any of these exist, immediately begin checking. Find out what is wrong before workers begin leaving.

There are many ways to improve human relations. One is to improve your understanding of human behavior. Accept the fact that some people do not look at things the same way others do. Respect differences of opinion. Be interested in all of the employees, not a select few. Correct poor conditions as soon as they become apparent. Keep employees informed and give them a feeling of security. Promote from within the organization. Show good workers that their extra efforts are recognized. Offer only constructive criticism,and then only in private. Never criticize one employee to another employee. See that the supervisors are fair. Give only correct information. Above all, be fair.

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

UNIT: Being Your Own Boss

TOPIC: Human Relations in a Business

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to:

1. discuss factors involved in the selection of personnel;
2. explain how to effectively train new employees; and
3. discuss the effects of good human relations and morale upon an employee's production.

REFERENCE: Student Information Sheet/Human Relations in a Business

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What must hiring be based on?

2. What organizations may be helpful in finding new employees for your company?

3. What is one of the best ways to get new employees?

4. What is the first step in evaluating potential employees?

BRICKLAYING STONE MASONRY

5. Why is an interview important?

6. What is the last step in the selection process?

7. What should all employees have when they begin a new job?

8. What determines the length of the training period?

9. What characteristics should the trainer of new employees have?

10. Why should the trainer include safety in the training program?

11. Name the four primary factors that lead to good morale.

12. How does poor morale affect the company?

13. What are indications of low morale?

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Trowels, Hammers, Chisels, and Mixing Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify trowels, hammers, chisels, and mixing tools used in bricklaying/stone masonry.

Types of Trowels

The trowel is the most important tool used by the masonry worker. Trowels are designed for handling small amounts of mortar and plaster. They are lightweight and well balanced for easy handling. Bricklayers and masons use brick trowels to pick up mortar and spread it on the wall or other construction unit in preparation for the next course (row) of brick, block, or stone. The blade and shank, or tang, are usually forged in one piece. The wooden handle is driven tightly onto the shank, or tang. The blade is usually taper-ground and polished, and the width at the heel is usually 5 to 5 1/2 inches. The Philadelphia pattern (figure 1) is one of the most popular brick trowels. The trowel varies from 10 to 12 inches in length. The London pattern (figure 2) has a rounded heel. This makes it possible for the mortar to be carried a little further forward on the blade. The length varies from 9 1/2 inches to 12 inches, and the width of the heel varies from 4 7/8 inches to 5 5/8 inches.

Cement trowels are used in finishing the surface of the cement to the required smoothness. Troweling action helps compact the surface and adds to the quality and durability of the concrete. Cement trowels are narrower and longer than plastering trowels, and the blade is often slightly convex. The blade is usually about 4 inches wide and 12 to 18 inches long.

Because the trowel is one of the most important tools masons use, it should be properly maintained. It should always be kept clean and free from rust. A dirty or rusted trowel slows down the work because fresh mortar has a tendency to adhere to rough places. A trowel should be stored in a special place when it is not in use.

Hammers

Several types of hammers are used in the masonry trades, and each has been designed for specific jobs or for specific materials.

Brick hammers. The brick hammer (figure 3) is used primarily to cut hard materials, although it can be used for driving nails. It consists of a square end used for making rough breaks, driving nails, and striking chisels or brick sets. The opposite end is used for dressing up and squaring off the end of the rough break. The handle is made of hardwood or steel cushioned with nylon plastic. The head is usually constructed of high-grade forged hammer steel and weighs from 12 to 24 ounces. The weight of the head usually depends upon the strength of the masonry worker. Most masons prefer the hardwood handle.

Tile hammers. The tile hammer is shaped much like the brick hammer, but it is smaller and weighs less. It is used for cutting glazed tile and enameled brick, and can be used in emergencies for facing brick. It should never, however, be used for striking brick set or driving nails because it is too light for these heavy-duty jobs.

Stone and concrete hammers. The stone hammer (figure 4) is made of forged and tempered tool steel. It is usually purchased with a 16-inch handle and weighs about four pounds. This heavy hammer is ideal for working with large and bulky stones. The concrete hammer, sometimes called a bush hammer, is constructed with milled teeth on the head of the hammer (figure 5). Some of these hammers are tapered for cutting. This hammer usually weighs between 2 and 4 pounds, and the milled head varies from 1 inches to 2 inches square. It usually has a hardwood handle.

Chisels and Jointing Tools

Clean, sharp cuts are important for facing brick. Although many brick cuts are made with a brick hammer, the blocking or bolster chisel (figure 6) is the instrument most commonly used. It has a broad edge and is made in a number of shapes and sizes. The most common has a beveled edge at the bottom of the wide blade. The chisel should be held so that the beveled edge faces the mason and so that the portion of the brick to be cut is away from the mason. The force of the blow varies with the type of cut and hardness of the material being used. The first sharp blow usually cracks the surface of the brick, and small taps square or smooth the rest of the cut. Cored bricks are harder to cut because they have a tendency to be weak at the core and may fracture at the wrong place. Always keep the cutting edge straight and sharp. The striking surface of the chisel should be free of burrs that might fly off and cause injury.

Jointing tools are available in several different shapes. One of the most popular types is the convex jointer (figure 7). After the mortar has begun to harden, the jointer is pulled along the joint (figure 8), and a smooth contour is formed. Other commonly used jointers are the V jointer, the concave stone beader, and the raker jointer, which is used to rake excess mortar from the joint. As with other tools, using the jointer requires practice to make smooth joints consistently throughout the construction project.

Mortarboards

A mortarboard is a surface constructed by wood, fiberglass, or polyethylene that is three to four feet square (figure 1). Masonry workers use this device to hold the mortar that they will pick up with their trowel to use directly on a wall or other masonry construction. The motarboard should be kept clean on the outer edges, and the mortar should stay pushed to the center. If the mortar is spread all over the board or if the trowel chops into the mortar, it dries quickly and hardens. When this happens, it is difficult for the bricklayer to pick up a clean trowelful, and the mortar is difficult to spread.

Mortar Hods

A mortar hod (figure 10) is a v-shaped box with one open end used to carry mortar. It is made of steel and aluminum, and its dimensions are about 24 inches by 12 inches by 12 inches. After filling the mortar hod at the mortar source, the hod carrier holds it upright by a support known as a mortar hod shank. The hod is then raised to the shoulder and carried up a ladder or runway to the mortarboard, where it is emptied from the open end.

A mortar hoe (figure 11) is necessary for mixing and tempering mortar. It usually has two holes through the blade, and the blade of the hoe is usually about ten inches long. The holes allow the mortar to slip through during mixing and produce a more even consistency. For small jobs, the mortar may be mixed in a mortar box or a wheelbarrow.

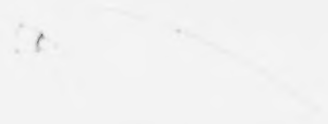


Figure 1. Philadelphia Trowel

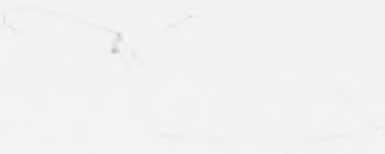


Figure 2. London Trowel

Figure 3. Brick Hammer

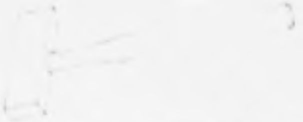


Figure 4. Stone Hammer

Figure 6. Brick Chisel

Figure 5. Toothed Concrete Hammer

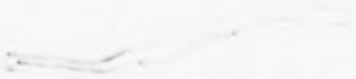


Figure 7. Convex Jointer

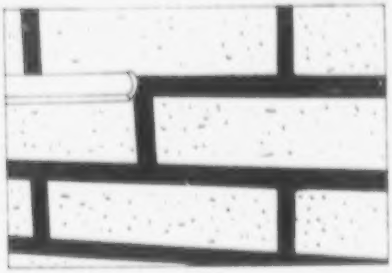


Figure 8. Jointing the Brick

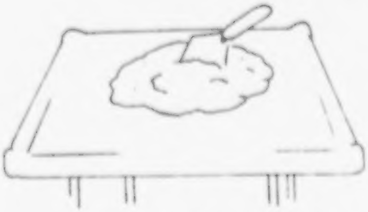


Figure 9. Mortarboard

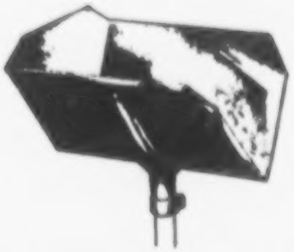


Figure 10. Mortar Hod

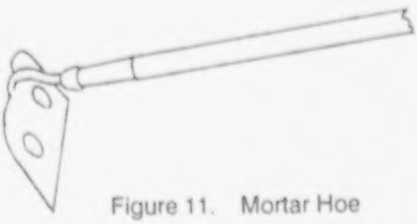


Figure 11. Mortar Hoe

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME________________________________ **DATE**________________

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Trowels, Hammers, Chisels, and Mixing Tools

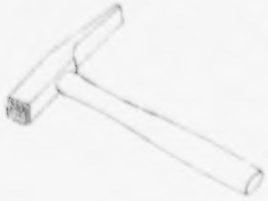
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to identify trowels, hammers, chisels, and mixing tools used in bricklaying/stone masonry.

REFERENCE: Student Information Sheet/Trowels, Hammers, Chisels, and Mixing Tools

DIRECTIONS: Identify each of the bricklaying/stone masonry tools shown by placing the correct letter in the blank.

A. Philadelphia trowel
B. Convex jointer
C. London trowel
D. Jointing the brick
E. Mortarboard
F. Mortar hoe
G. Brick hammer
H. Stone hammer
I. Brick chisel
J. Toothed concrete hammer
K. Mortar hod



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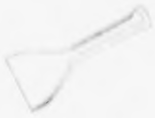

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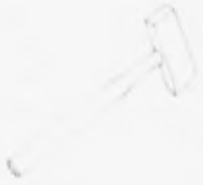

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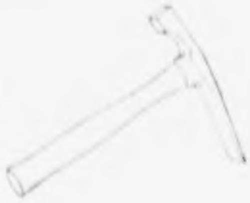

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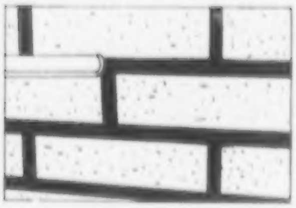

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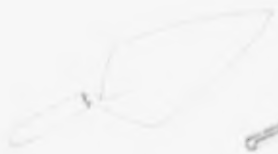

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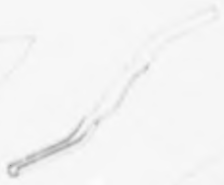

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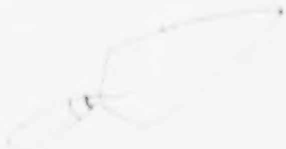

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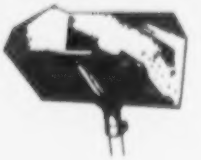

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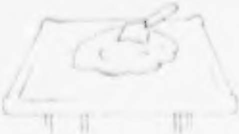

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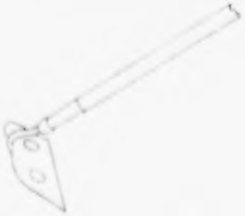

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JOB SHEET

BRICKLAYING/STONE MASONRY

NAME:______________________________ **DATE:**____________________

UNIT: Introduction to Bricklaying/Stone Masonry

NAME OF JOB: Using Bricklaying/Stone Masonry Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to use a bricklaying/stone masonry tool.

TOOLS AND EQUIPMENT: Display of bricklaying/stone masonry tools

MATERIALS: No materials are required.

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Select one tool from the display.
2. Using proper safety precautions, demonstrate how the tool should be used.
3. Replace the tool.

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Introduction to Bricklying/Stone Masonry

TOPIC: Measuring and Leveling Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify measuring and leveling tools used in bricklaying/stone masonry.

Rules and Tapes

The spacing rule (figure 1) consists of a series of marks representing course heights for different thicknesses of brick or mortar joints. It is used in laying out the corner or story pole and is also used for laying out arches over openings.

Spacing tapes are usually ten feet in length and contain modular markings for all common brick. Feet, inches, and fractional parts of an inch are commonly found on one edge of the blade.

Squares

Masonry workers do not usually have great need for a framing square, but they can use a small steel square, try square, or combination set. These are easy to carry and store and are necessary in keeping jambs and corners square. They are also convenient for marking bricks for cutting and other small squaring needs.

Plumb Rule

The plumb rule (figure 2), one of the mason's most important tools, is made of either hardwood or metal and is very delicate. it is lightweight and must be completely straight.

The spirit-level vials, which are inserted into the rule, measure both vertical and horizontal levelness. Plumb rules may be purchased in long or short sizes. Long levels measure from 42 to 48 inches, and short levels are available in lengths of 12 or 24 inches. The short levels are useful in setting both soldier courses and rowlock sills and for starting corners.

Although plumb rules are tested at the factory before shipping, they may become inaccurate through mishandling. A plumb rule should be checked as soon as it is purchased as well as periodically during its use. The easiest way to determine its accuracy is to check an object for levelness, determine where the bubble in the vial is located, and then reverse the plumb rule. If the bubble is between the two center marks in one direction, it should be in the same place when the plumb rule is reversed.

Mason's Line

A mason's line should be used on walls that are four feet long or longer. This line helps keep the brick or stone in the wall straight, level, and plumb. Masonry guides or story poles are placed at the corners of the structure being built, and the mason's line is attached to them so that it can be tightened.

The brick is then placed with the top of the brick even with the stretched line. The mason raises the line as each course (row of brick or stone) is finished.

A mason's line is usually made of strong nylon so it can withstand the stress when it is tightened. When fastening the line, the mason on the left-hand lead (peg end) attaches the line at the proper course to the left-hand lead. Then the mason on the right-hand lead (pin end) pulls the line tightly and fastens it to the lead at that end. The line should be pulled until all sag has been eliminated. Any sag will cause the bricklayer or stonemason to lay an uneven course. If there is sag on a long wall and it cannot be eliminated, a trig will be needed. A trig is a short piece of line that is looped around the main mason line and fastened to the top edge of the trig brick or stone. On extremely long walls, several trigs may be needed.

After the mason's line has been stretched into place, it should be touched as little as possible. The mortar should be spread so that the trowel or mortar does not touch it. The beginning mason may have some trouble in keeping his thumb free of the line, and an experienced mason may have little patience with the mason who constantly has his "thumb on the line." After the brick or stone has been set, it should never touch the line. If it does, it will "crowd" the line and will result in the wall's bulging at various points.

Masonry Guide

A masonry guide is used to lay all brick or stone in a wall without having to set up leads. This useful tool is usually made of metal and contains line blocks, or line carriers. These carriers are attached to the poles and can be moved up or down the pole, course by course. The masonry guide replaces the story pole in almost all jobs since the coursing scale is placed upon the guide pole itself. The line blocks, or carriers, are set to each coursing mark. The masonry guide has fittings that allow the pole or support to be braced in a plumb position while still being free of the masonry wall being built. For veneer work, the top of the guide can be attached to the frame wall by means of a special fitting and plumbed independent of the frame.

After the masonry guides are set and plumbed and after the mason's lines are stretched from one guide to the other, the mason can start laying brick or stone to the line without stopping to build leads. A masonry guide is shown in figure 3.

Story Pole

The story pole (figure 4) has been almost replaced by the masonry guide, but it is still available and used by some masons. It is a stick or pole usually about ten feet long or one story high. It is one inch thick by two inches wide. The pole should be marked on three sides with joint heights or brick gages. On the fourth side, sills, lintels, and frame heights should all be marked at different levels. The pole must be laid out so that the thicknesses of the joints will match the heights of the sills, lintels, frames, and walls.

The story pole is normally set on a nail on the outside of the job or on the first floor level on the inside. Wherever it is set, the story pole is usually on the same level as the outside. Since the heights of the windows and doors do not always match the joint's heights, the difference is made up by the thicknesses of the bed joints in the brickwork.

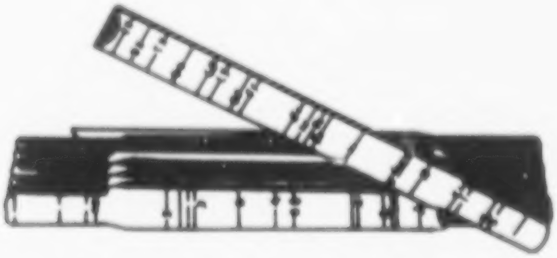


Figure 1. Six-Foot Spacing Rule

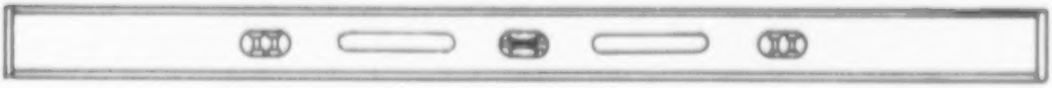


Figure 2. Mason Level

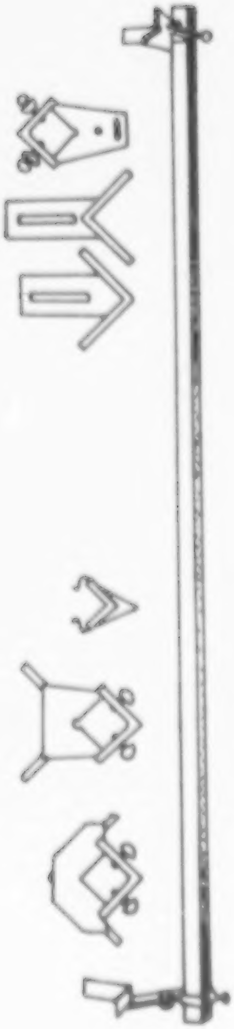


Figure 3. Masonry Guide

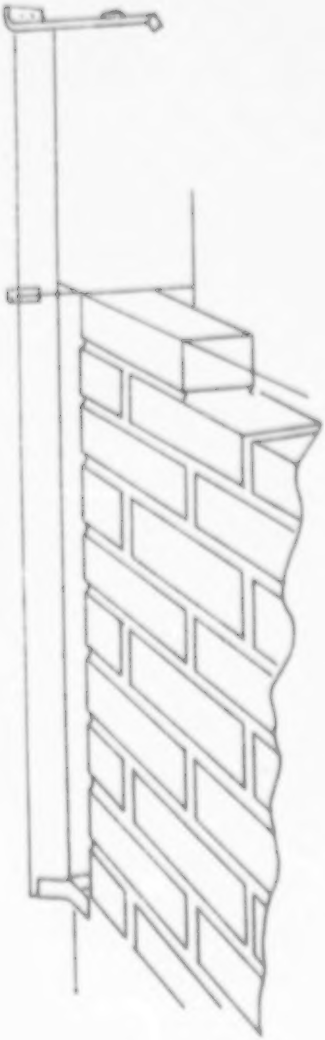


Figure 4. Story Pole

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME______________________________________DATE________________

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Measuring and Leveling Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to identify measuring and leveling tools used inbricklaying/stone masonry.

REFERENCE: Student Information Sheet/Measuring and Leveling Tools

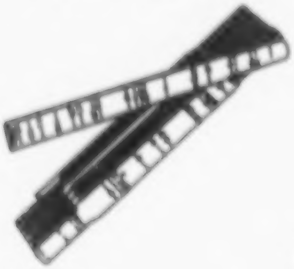
DIRECTIONS: Identify each of the bricklaying/stone masonry tools shown by placing the correct letter in the blank.

A. Story pole

B. Six-foot spacing rule

C. Plumb rule (level)

D. Masonry guide



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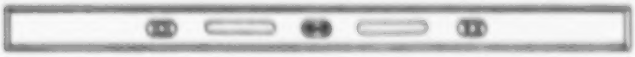

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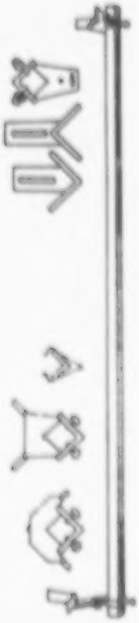

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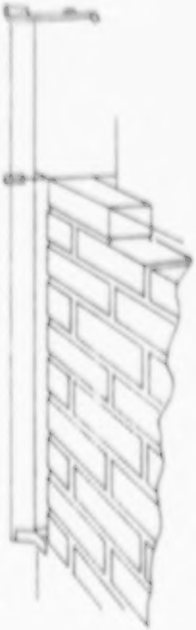

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STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Heavy Masonry Equipment

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify heavy masonry equipment.

Hoisting Devices

Gin poles, breast derricks, and **pole derricks** are hoisting devices commonly used for lifting stones on buildings that are not more than two or three stories high. Larger buildings of fireproof construction (in which the floors are held by a skeleton steel frame built in advance of the erection of the enclosing walls) require a small derrick or derrick boom attached to the frame of the building.

The gin pole is a pole held in position by guy wires with a block and tackle at the top for hoisting the stone. The block and tackle may be operated either by hand or by a winch. The breast derrick (figure 1), which has two upright supports latticed together in the form of a ladder, has a winch at the bottom. The derrick leans against the wall or is supported by guy wires. It is usually operated by hand. The pole derrick (figure 2) combines the feature of the gin pole and the breast derrick. It is a square pole, mounted and braced on a base member which rests on small wheels and is fitted with a winch, pulleys, and tackles.

There are several ways of picking up the stone and attaching it to the block and tackle of a derrick so that it may be hoisted into position. The stone may be lifted with "dogs" (figure 3) that are attached to the derrick sling. This method can be used only where vertical joints occur in both ends of the stone. Lewises may also be used (figure 4). The type of lewis most commonly used for lifting a stone in the horizontal courses of the cornice is the pin lewis. It has two pins that are from 5/8 to 1 inch in diameter and rings that are attached in the ends and carried by means of a sling. These pins are inserted in the top bed of the stones in holes which are drilled diagonally toward the center near each end. A similar pin lewis has two pins that are carried by a ring instead of a sling. It is used for lifting smaller, square-shaped blocks.

A steel grabhook, which looks much like a large pair of ice tongs, is commonly used to hold small stones during placement. A block of wood, which may be surfaced with lead, is placed between the spring of the grabhook and the face of the stone. This protects the face of the stone. On the back of the stone, a small depression is chiseled to receive the other prong of the grabhook.

Brick tongs (figure 5) are used to carry small quantities, usually from six to ten bricks. Brick tongs are made of flat malleable iron or tubular steel. Adjustments to carry a certain number of units can be made in seconds.

Masonry Cutters

There are several types of masonry cutters or splitters, but the two most common are the hydraulic cutter and the hand splitter. The hydraulic cutter (figure 6) is operated by a hydraulic pump. When the blade is placed against the stone, and the handle is pumped, the pressure splits the stone. The units are usually constructed of high-grade steel with hard edge blades. The hand splitter (figure 7) is used in conjunction with a heavy hammer or sledge. The stone is positioned beneath the blade at the indicated cut. Then a two to four pound hammer gives the upper edge of the blade a solid blow. The stone then parts at the point of impact. This type of splitter is used by the mason who does not do a great deal of stonework.

Masonry Saws

The masonry saw (figure 8) comes in a variety of sizes, but the 14 to 20 inch blades are the most common. Some masonry saws cut wet, and others are used without lubrication. Those with water pumps are more expensive. Masonry saws can be adjusted to cut different sizes.

Portable Concrete Mixers

The mason who does small jobs has a great need for a concrete mixer because these jobs generally will not require the services of a truck mixer. Many masons use a portable mixer because it is easy to place at the building site. The wheelbarrow type (figure 9) is very convenient, and it may also be used as a wheelbarrow. While most mixers have revolving drums containing fixed blades inside, some types have fixed drums with revolving blades or paddles. They are usually powered by an electric motor fastened to the upper frame. Mixers should be cleaned immediately after each use.

Scaffolds

Although scaffold safety was covered at the first of this manual, you should know what types of scaffolds are used.

The **swing-stage scaffold** has been used for many years in the construction of tall, skeleton-frame buildings, but the advantages of these continuously adjustable scaffolds were not fully realized until recently. When using these scaffolds, the bricklayer can keep materials handy and work at convenient heights. This eliminates much of the unnecessary fatigue encountered otherwise.

The **tower scaffold** has vertical towers that are braced to the building being constructed. A carriage provides the mason's materials, and there are platforms that can be raised by a hand winch suspended by a cable from the top of the tower.

The **tubular scaffold** with adjustable brackets (figure 10) places the platform at various heights so the mason and the materials are always at a **workable height**. Many types may be adjusted for high, long, or wide jobs.

Wheelbarrows

Although wheelbarrows may be constructed of either steel or wood, most that are used for transporting mortar are made of metal because of the excessive weight. Brick and tile wheelbarrows (figure 11) are usually made of wood and can carry up to 120 bricks. Wheelbarrows are used when it is impossible to use other vehicles to transport mortar, brick, or tile to the construction site.

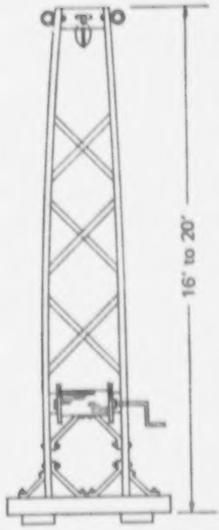


Figure 1. Breast Derrick

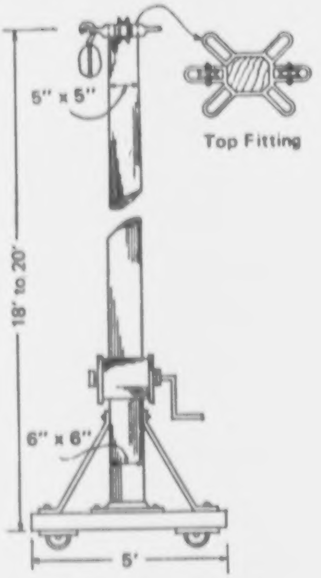

5" x 5"
Top Fitting
18' to 20'
6" x 6"
5'

Figure 2. Pole Derrick

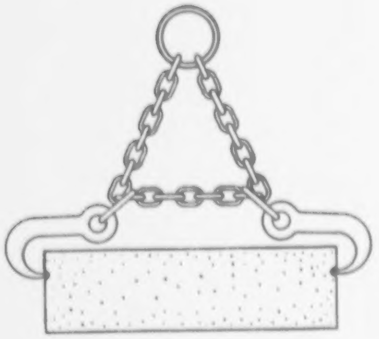
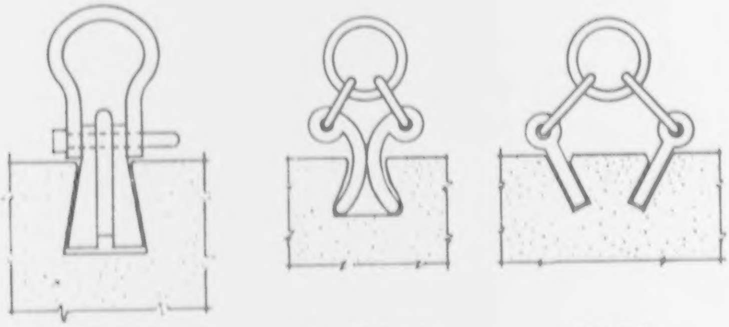


Figure 3. Masonry Dogs



Three-leg Lewis

Knuckle Lewis

Pin Lewis

Figure 4. Masonry Lewises

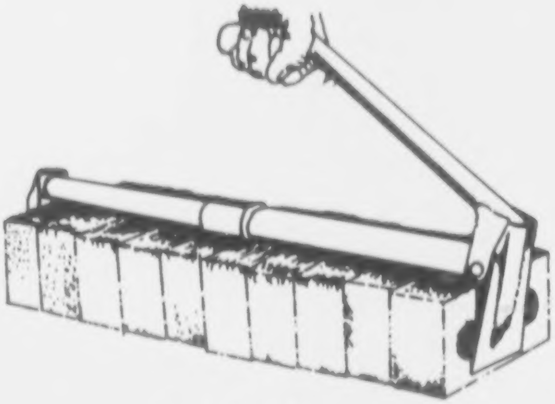


Figure 5. Brick Tongs

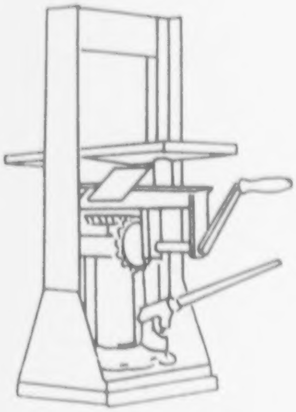


Figure 6. Hydraulic Cutter

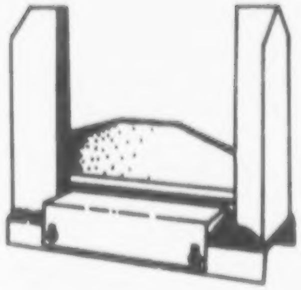


Figure 7. Hand Splitter

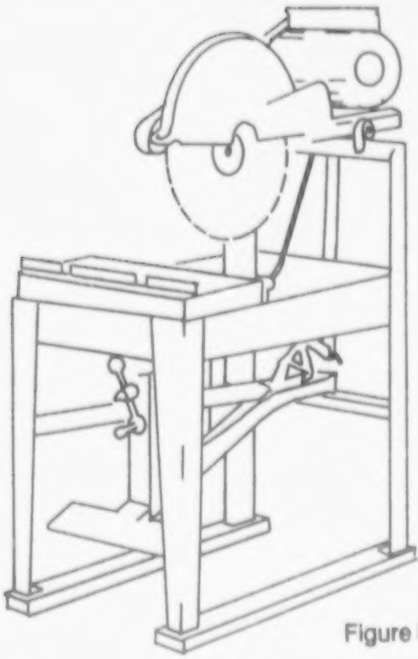


Figure 8. Masonry Saw

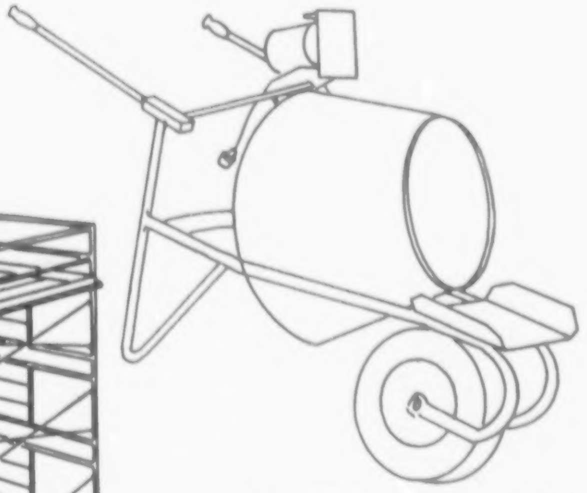


Figure 9. Wheelbarrow Concrete Mixer

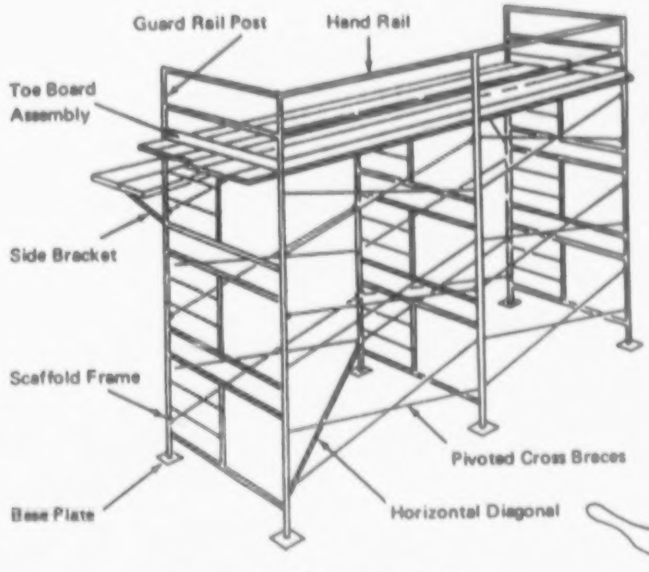

Guard Rail Post
Hand Rail
Toe Board Assembly
Side Bracket
Scaffold Frame
Base Plate
Pivoted Cross Braces
Horizontal Diagonal

Figure 10. Tubular Scaffold

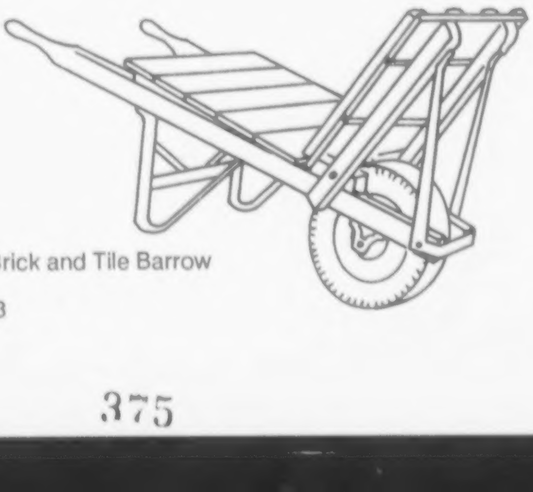


Figure 11. Brick and Tile Barrow

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME____**DATE**__________________

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Heavy Masonry Equipment

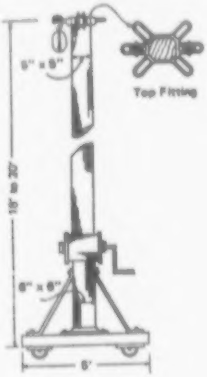
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to identify heavy masonry equipment.

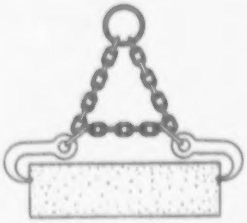
REFERENCE: Student Information Sheet/Heavy Masonry Equipment

DIRECTIONS: Identify each of the bricklaying/stone masonry tools shown by placing the correct letter in the blank.

A. Pole derrick
B. Masonry dogs
C. Hand splitter
D. Hydraulic cutter
E. Brick and Tile Barrow
F. Breast Derrick



1. ____



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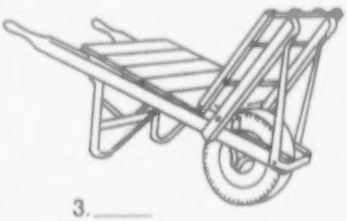

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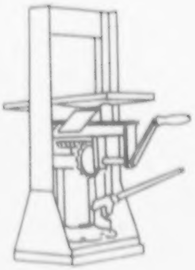
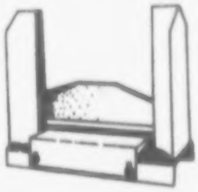
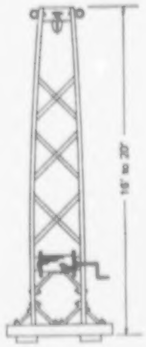


4. ____



5. ____



6. ____

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Introduction to Bricklaying/Stone Masonry.

TOPIC: Materials Used in Bricklaying/Stone Masonry.

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify materials used in bricklaying/stone masonry.

When working in bricklaying/stone masonry, there are many materials you will use. These materials come in a variety of forms. To begin with, it is important that you become familiar with the materials which you mix before using them. These include cement, lime, mortar, and concrete.

Cement consists of finely ground compounds of lime with silica, alumina, and iron oxide added. There are two methods used to manufacture this cement. These methods are the dry process and the wet process. In the dry process, the raw materials are ground up, mixed, and fed into a kiln (oven). In the wet process, the raw materials are ground, mixed, and fed into a kiln containing water.

Lime, which is often used with cement or mortar in residential and commercial construction, is a product of limestone. When it is heated to l,700° F, the material left is known as quicklime. A chemically treated quicklime called hydrated lime is used today.

Mortar may be a mixture of lime, sand, and water; lime, sand, cement, and water; or cement, sand, and water. The two basic types of mortar are that for unit masonry (C720) and that for reinforced masonry (C476).

Concrete is a mixture of portland cement, aggregates (sand, gravel, crushed stone, or a combination of any of these), and water. Other types of materials used in bricklaying/stone masonry include brick, tile, block, and stone.

Bricks are building units made of baked clay. Bricks vary in size, but one with a length of 8 inches, a width of 3 3/4 inches, and a depth of 2 1/4 inches is considered standard. The American Society for Testing and Materials has classified the most commonly used brick into three categories. A C-62 brick is a building brick; a C-216 brick is a facing brick; and a C-126 identifies either a ceramic-blazed structural clay facing title, a facing brick, or a solid masonry unit (figure 1). Hollow tile is a brick material used commercially where bricks are used in partitions and for furring. Tiles are made in various sizes and are usually larger than bricks. Tile offers more bulk without a corresponding increase in weight (figure 2).

Concrete blocks are made in a variety of sizes and shapes. The 8 inch by 16 inch size is probably the most widely used. Concrete blocks are constructed with cores, or air spaces, that take up about 50 percent of the total volume (figure 3).

Stone is also used in bricklaying/stone masonry. The most commonly used stones in the United States are gilmestone, granite, sandstone, bluestone, and marble (figure 4).

The remaining materials used in bricklaying/stone masonry include metal ties, steel bearing plates, and flashing.

Metal ties are used in walls to tie together separate tiers, or wythes. Sometimes metal ties are used to attach brick veneer to walls with wooden frames or to other structural walls (figures 5-6).

Steel bearing plates are placed on walls or piers to support steel beams or girders. They distribute the weight over a larger area (figure 7).

Flashing is made of flat sheet metal and is installed to divert moisture to the outside of the structure (figure 8).

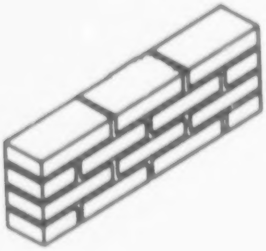


Figure 1. Bricks

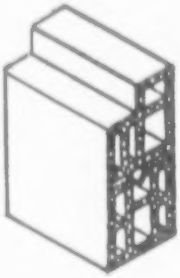


Figure 2. Hollow Tile

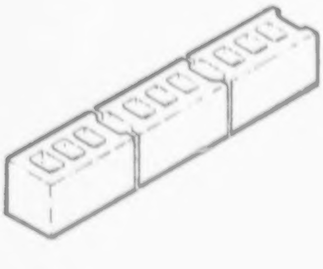


Figure 3. Concrete Blocks

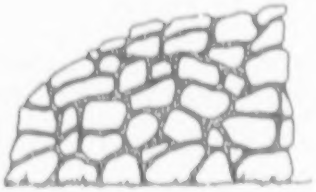


Figure 4. Stone

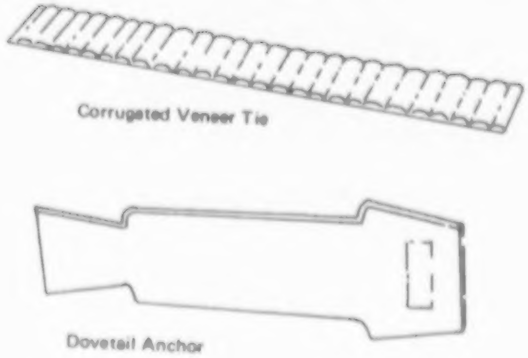

Corrugated Veneer Tie
Dovetail Anchor

Figure 5. Brick Veneer Ties

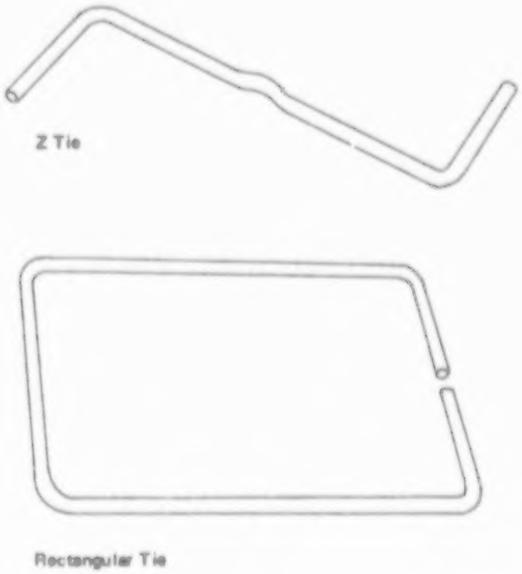

Z Tie
Rectangular Tie

Figure 6. Wall Ties

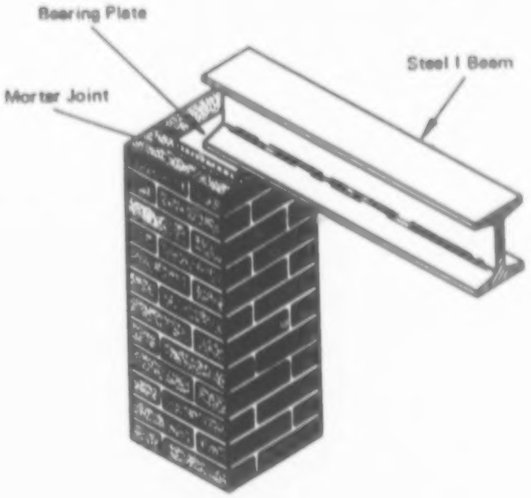

Bearing Plate
Steel I Beam
Mortar Joint

Figure 7. Steel Bearing Plate

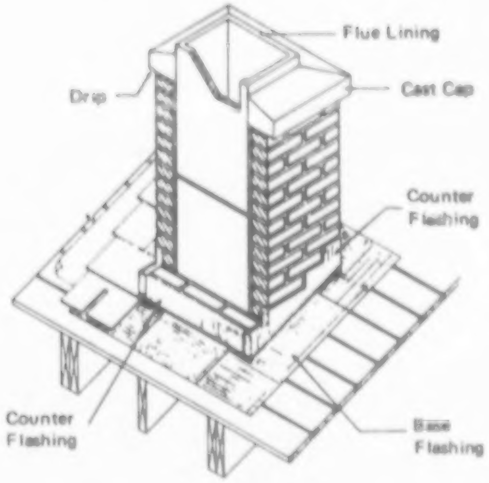

Flue Lining
Drip
Cast Cap
Counter Flashing
Counter Flashing
Base Flashing

Figure 8. Chimmey Flashing

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

UNIT: Introduction to Bricklaying/Stone Masonry

TOPIC: Materials Used in Bricklaying/Stone Masonry

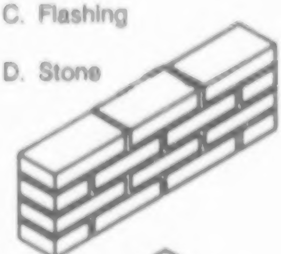
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify materials used in bricklaying/stone masonry.

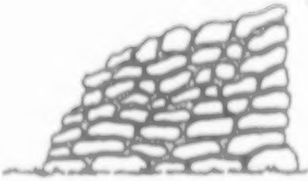
REFERENCE: Student Information Sheet/ Materials Used in Bricklaying/Stone Masonry

DIRECTIONS: Identify each of the materials shown by placing the correct letter in the blank.

A. Wall ties
B. Brick
C. Flashing
D. Stone
E. Steel bearing plate
F. Hollow tile
G. Brick veneer ties
H. Concrete blocks



1. ____



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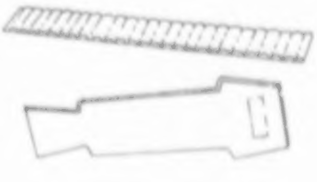

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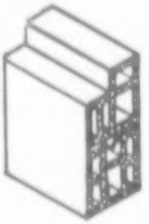
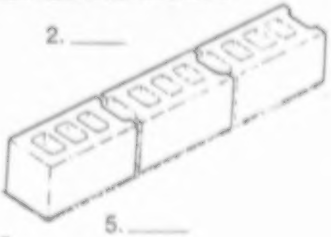
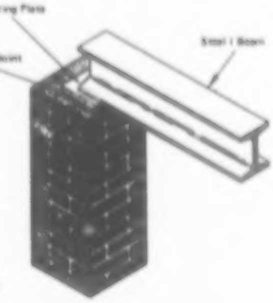


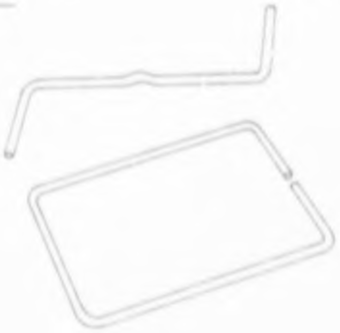
4. ____



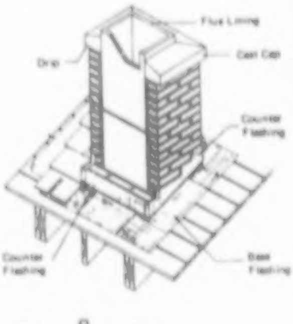
5. ____


Bearing Plate
Mortar Joint
Steel I Beam

6. ____



7. ____


Flue Lining
Drip
Cast Cap
Counter Flashing
Counter Flashing
Base Flashing

8. ____

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT:	Introduction to Bricklaying/Stone Masonry
TOPIC:	Mathematic Skills Used in Bricklaying/Stone Masonry
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will have a knowledge of the mathematic skills necessary in bricklaying/stone masonry.

You may wonder what bricklaying/stone masonry has to do with mathematics. It is impossible to work as a bricklayer without the necessary mathematic skills. The bricklayer uses many types of rules and squares for measuring. The 12-inch rule is divided into 12 equal parts or inches. This means that each inch is equal to 1/12 of the whole 12 inches. As you can see when working with a rule or square, you must know how to work with fractions or parts of a whole (figure 1).

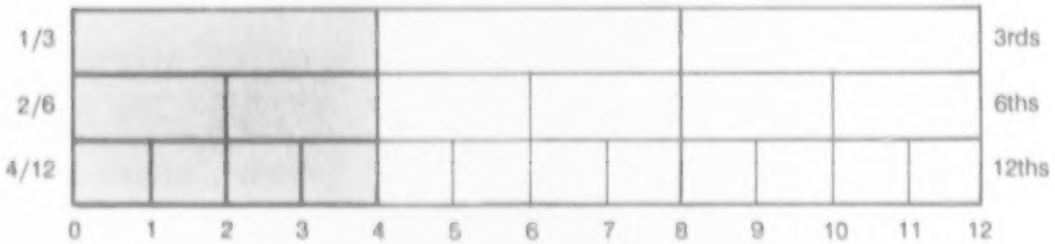


Figure 1. Dividing lengths into fractions

Often, it is necessary for the bricklayer or stonemason to deal with percentages, ratios, and proportions. You will find that these skills are used when mixing materials such as cement, lime, mortar, and concrete. Table 1 is a good example of how proportions are used.

Table 1
Proportions for Lettered Types of C270 Mortar

Portland Cement-Lime Mortars

Type	*Portland Cement*	*Hydrated Lime or Lime Putty*	*Sand*
M	1	¼	3
S	1	½	4½
N	1	1	6
O	1	2	9
K	1	3	12

Masonry Cement Mortars

Type	*Portland Cement*	*Masonry Cement Type II*	*Sand*
M	1	1	6
S	½	1	4½
N	—	1	3
O	—	1	3

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

UNIT:	Introduction to Bricklaying/Stone Masonry
TOPIC:	Mathematic Skills Used in Bricklaying/Stone Masonry
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will demonstrate a knowledge of the mathematic skills necessary in bricklaying/stone masonry.
REFERENCE:	Student Information Sheet/Mathematic Skills Used in Bricklaying/Stone Masonry
DIRECTIONS:	Identify the fractional proportions of the shaded areas of the figures below by writing the correct letter in the blank.

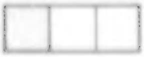
A. 1/5

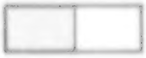
B. 1/3

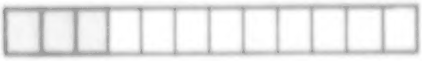
C. 3/4

D. 1/2

E. 1/4

1. ___


2. ___


3. ___


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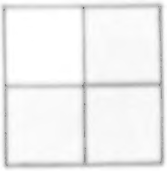
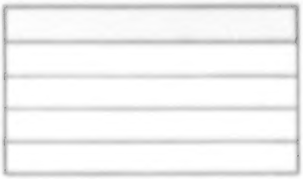


5. ___


STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT:	Fundamentals of Bricklaying/Stone Masonry
TOPIC:	Reading Drawings and Blueprints
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be familiar with various types of drawings and blueprints utilized by bricklayers/stone masons.

Before you can successfully do any masonry work, you must know what the architect, contractor, or homeowner desires. To do this, you must be able to read blueprints. Blueprints tell what type of reinforcement is needed, the dimensions of the structure, and where masonry is to be located. You should be able to look at a blueprint and know immediately what is expected.

Conventional Lines

When checking a blueprint, you will discover that the drafter uses many types of lines to give you information. Line characteristics--such as width, zigzags, line breaks, and curves--give you important information. The various kinds of conventional lines appear in figure 1.

Center lines. These lines are made up of long and short dashes. Long dashes appear at each end and alternate with short dashes, evenly spaced, along the entire length of the centerline. Centerlines extend about 1/4 inch past the outside of the object. Where centerlines intersect, small dashes overlap. These crossed lines locate the center of the object.

Visible lines. Visible lines are solid, thick lines. Visible lines indicate the outside borders of the object drawn. These lines are also used to define edges or lines that are visible within the object.

Hidden lines. Hidden lines are thin, short dashes. The hidden line begins with a dash that is in contact with the starting line, unless an unbroken line is being continued.

Extension lines. Extension lines, which are thin and unbroken lines, begin about 1/16 inch from the object outline. These lines extend about 1/8 inch further than the outside dimension line, so that dimensions may be read easily. They are parallel to each other and are at 90-degree angles to the distance that is shown. Where extension lines cross each other, they are broken.

Dimension lines. Dimension lines are thin and unbroken to allow for the insertion of dimension numbers. They are used between extension lines to indicate distances on a drawing. An arrowhead usually appears on each end of a dimension line to indicate where the distance begins and ends. When the radius of an arc is dimensioned, an arrowhead appears only at the end of the line that touches the arc. The end without an arrow stops at the location used as the center of the arc.

Leaders. A leader is a thin line that angles and ends in either an arrowhead or a dot at the drawing detail. Leaders are used on drawings to identify numbers, notes, or references with a particular line, opening, or detail. A short line extends from the identification parallel to the numbers or letters.

Break lines. Short break lines are shown with thick, wavy freehand lines. Long break lines are shown with thin, zigzag lines. These are used to save drawing space and shorten the length of a drawing when a long object has a continuous shape and size throughout its entire length. Sometimes, the drawing of a chimney or the length of a wall is shortened by this means.

Phantom lines. These long and short dashes are used to show positions or paths of movable objects or parts. This is important if the swing of one part interferes with another part that is either movable or stationary. An example would be phantom lines on a drawing to show the path in which a damper in a fireplace will swing when it opens.

Cutting-plane lines. Cutting-plane lines are thick, long and short dashes that angle and end in arrows. These lines indicate openings or parts that do not show from the outside of the object and exposes them to view. Even though hidden lines could be used, too many lines sometimes obscure the parts that should be shown. The arrows on the ends of cutting-plane lines show from which direction the sections are being viewed.

Symbols. Symbols are used when there is not enough room on the drawing to show a complete object. They give definite meaning for a number of items. Although it is important to be able to recognize electricity, plumbing, and heating symbols, the most important symbols that the mason should know are those that show openings in walls and materials to use.

Details

Because floor plans are so small after they have been scaled down, it is impossible to draw in all the details. For this reason, a sheet or sheets are added to the blueprints and drawn on a larger scale. Structures that are shown on these sheets include kitchen cabinets, stairways, fireplaces, and other built-ins. These extra sheets also contain any dimensions that will be needed during construction.

Sections

Sections are drawings that show a cutaway of an object, a building, or a part of a building. These drawings allow you to see the true shape of an object and its relationship to other parts. Sometimes the only way you can see hidden parts is by looking at a sectional view. Sections are often drawn of walls, fireplaces, stairs, windows, and interior trim.

Schedules

Schedules are tables that give information about various units that may be factory-made and installed at the structure. They are usually found with the floor plans. By loking at the schedule, you can get the dimensions of the unit in question and then allow the space needed for its insert.

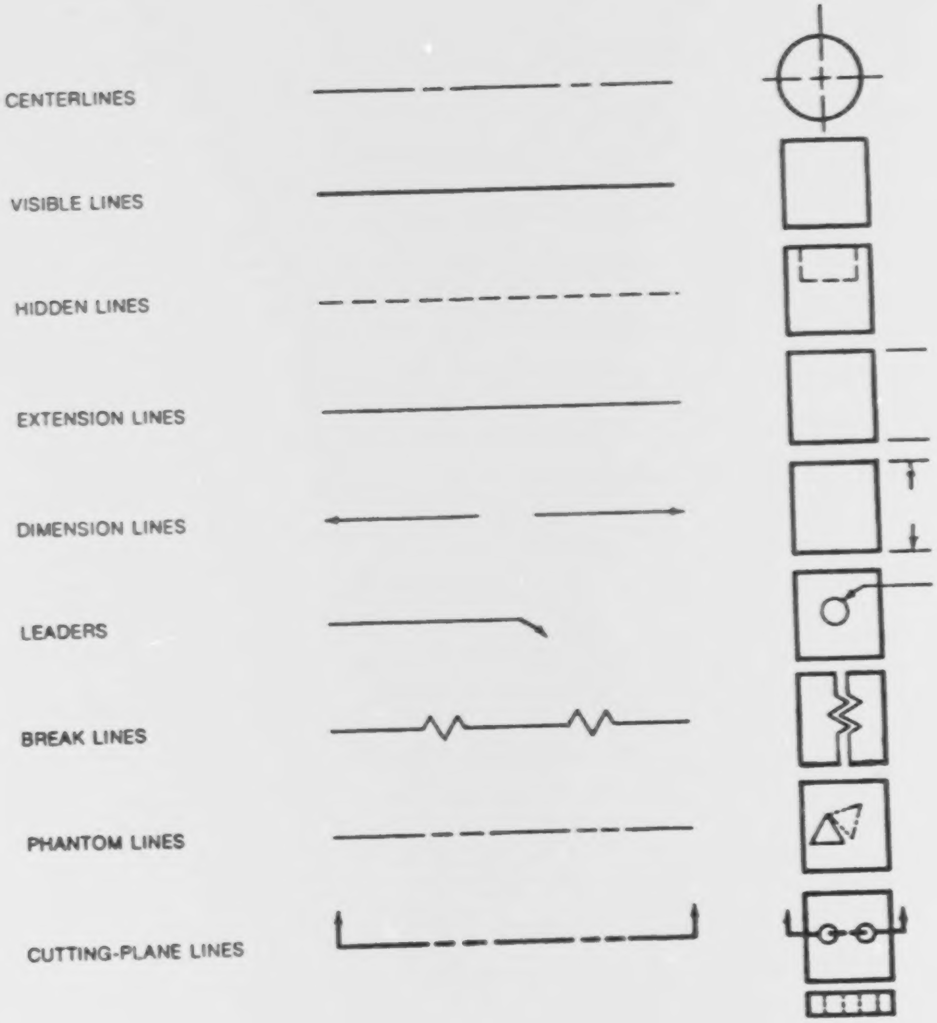

CENTERLINES
VISIBLE LINES
HIDDEN LINES
EXTENSION LINES
DIMENSION LINES
LEADERS
BREAK LINES
PHANTOM LINES
CUTTING-PLANE LINES

Figure 1. Conventional Lines

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME____**DATE**_________________

UNIT:	Fundamentals of Bricklaying/Stone Masonry
TOPIC:	Reading Drawings and Blueprints
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will be familiar with various types of drawings and blueprints utilized by bricklayers/stone masons.
REFERENCE:	Student Information Sheet/Reading Drawings and Blueprints.
DIRECTIONS:	Read and answer each of the following questions in the space provided.

1. What types of dashes make up centerlines?

2. What is the purpose of visible lines?

3. Why are dimension lines broken?

4. Why are leaders used on drawings?

5. What kind of line is used to shorten the length of a drawing?

6. What kind of line shows positions or paths of movable objects or parts?

7. Why is it necessary to use symbols on a blueprint?

8. What are the most important symbols for a masonry worker to be able to recognize?

9. How are small details shown on a blueprint?

10. What do sections show?

11. What does a section drawing allow you to see?

12. What information can you get from a schedule?

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Using Masonry Ties

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to understand the use of masonry ties.

Metal Ties

Walls in which the separate tiers, or wythes, are tied together or bonded by metal ties are better for some uses than similar walls bonded with masonry units or brick headers. Sometimes metal ties are used to attach brick veneer to walls with wooden frames or to other structural walls.

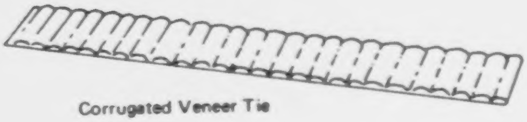
Veneer ties are smaller gauged than the ties used in cavity or metal-tied walls. When veneer ties are used, the veneer cannot be considered to be part of the required thickness of the wall. For instance, if a building code specifies that the minimum thickness of a masonry wall is eight inches for a certain structure and the wall is veneered with four inches of brick attached to the backup with veneer ties, the backup must be the required eight inches. If the mason uses heavier ties, the backup necessary is only four inches because the four inches of brick veneer is then part of the required eight-inches thickness.

The corrugated veneer tie and the dovetail anchor are two types of ties that are normally used to attach brick veneer to backing walls (figure 1). The corrugated metal tie is commonly used to attach brick veneer to wooden frames. These metal ties are usually constructed of galvanized steel with at least a 7/8-inch width and a 22-guage thickness. There should be one of these metal ties for each two square feet of wall area. The ties should not be spaced further than 24 inches apart either horizontally or vertically.

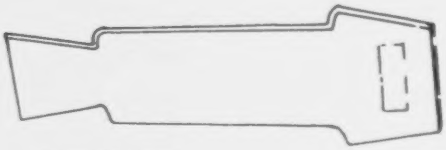
Corrugated ties should be fastened to the wall studs with eightpenny nails. Care should be taken that they are not nailed to the sheathing, especially fiberboard sheathing, because the material is not strong enough to hold the nail in place. Because most studs are spaced on 16-inch centers, the maximum vertical spacing of the ties can be figured by dividing 288 square inches by 16 inches; the answer is 18 inches. For brick application of three courses to every eight inches, this requires one row of wall ties for every sixth course.

The dovetail anchor is used to attach brick veneer to concrete walls, columns, or beams. This tie fits into a slot formed in the concrete. The dovetail is at least 7/8-inch wide and constructed of 16-guage material.

Metal ties for cavity and metal-tied walls are the Z tie and rectangular tie (figure 2). The Z tie is used when walls are constructed of brick or other solid masonry units. The rectangular tie is used in walls where one or both wythes are of hollow units. The ties are constructed of copper or zinc-coated steel with a 3/16-inch diameter. They are usually placed so that there is one tie for each 4 1/2 square feet of wall surface. Sometimes there is a combination of metal ties and joint reinforcement.

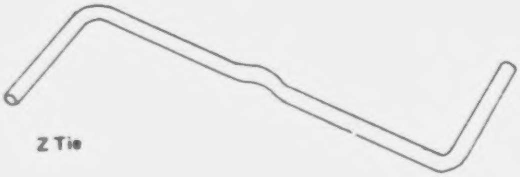


Corrugated Veneer Tie

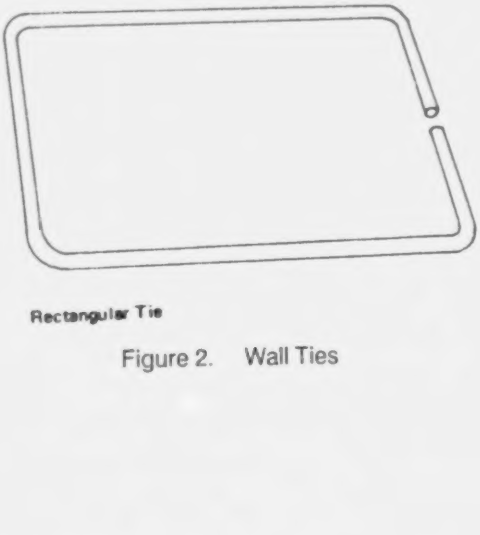


Dovetail Anchor

Figure 1. Brick Veneer Ties



Z Tie



Rectangular Tie

Figure 2. Wall Ties

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME____ DATE____________

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Using Masonry Ties

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to understand the use of masonry ties.

REFERENCE: Student Information Sheet/Using Masonry Ties

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. How do veneer ties differ from those used in cavity or metal-tied walls?

2. Where are the corrugated metal ties used?

3. How should corrugated ties be fastened to wall studs?

4. Where is the dovetail anchor used?

5. From what material is the Z tie constructed?

6. Why should corrugated ties not be fastened to sheathing?

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Using Reinforcing Bars

UNIT OBJECTIVE: After competition of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to understand the use of reinforcing bars.

When a structure is subjected to greater than normal stress, reinforced brick construction must be used. Reinforced brick masonry is masonry consisting of brick, mortar, grout, and reinforcing steel. Tests are run to determine how much steel or reinforcement is needed and what type of construction will be necessary for the structure.

Masonry Stresses

Brick walls are usually subjected both to compressive forces and to lateral forces. Compressive forces may be found in vertical loads that consist of the weight of the building, known as the dead load, and the weight of the contents, known as the live load. These loads cause the walls to shorten or compress. Lateral forces include wind loads, earth pressures, and forces resulting from earthquakes. Stress is the resistance of a structure against a force.

Figure 1 shows the compression stress found in brick construction. The structure is subjected to vertical loads during this condition, and the complete unit has a tendency to be shortened. The ultimate strength of the structure depends mainly upon the compressive strength of the mortar. The quality of work applied during construction also has an important effect on the strength of the structure.

Figure 2 illustrates the type of stress known as shear. This type of stress usually occurs when the wind is blowing against one of the walls.

Tension stress (figure 3) occurs when applied loads tend to pull the brick units apart. Resistive measures depend on the composition of the mortar. Strengths may be increased by adding higher percentages of portland cement or increasing the water in the mortar mixture. When the brick is wetted before mortar is applied, the strength of the bond increases.

When weight is placed on a beam or wall that is supported at two or more points, the structure will bend to a certain extent. This type of structure is called a flexural member. Sometimes wind pressure against exterior walls also causes bending. When bending takes place, the stresses of compression and tension occur (figure 4).

Materials

Steel is normally used in flexural members so that tensile and shearing stresses may be carried. Masonry materials are usually strong enough to withstand compressive stresses without additional reinforcement, but reinforcement steel must be placed where tensile and shearing stresses will occur.

Reinforcement bars are placed parallel to the length or height of a flexural member in order to give tensile reinforcement. Bent bars or stirrups are placed at right angles to the length or height of flexural members to give shear reinforcement. Brick used in reinforced brick masonry is about the same as that used in standard masonry structures. As in other types of construction, high-suction brick must be wetted before mortar is applied.

Grout and mortar should meet standard specifications. The mortar should be mixed with as much water as can be used and still be a workable mixture. Two types of grout are normally used. Fine grout is used when the grout space is not over two inches in thickness; course grout is used for spaces thicker than two inches.

Reinforced Brick Construction

Vertical reinforcing steel is usually placed before construction begins. The steel should be securely tied in place and braced while construction proceeds. This prevents the steel from moving and causing the bond between the steel and mortar to be destroyed. Horizontal reinforcement rods may be placed in position as the job progresses. Both vertical and horizontal bars should be completely covered with mortar or grout.

During reinforced masonry construction, it is very important to completely fill all mortar joints. When joints are not filled, not only maximum bond but also compressive and shearing strengths may be affected. Dry mortar should not be allowed to drop into the grout space at any time.

A tapered bed of mortar (figure 5) should be used to prevent excess mortar from dropping into the grout space. This taper allows full bed joints but prevents mortar from extending beyond the brick into the grout space. If excess mortar does protrude but does not extend more than 1/2 inch over the grout space, it should be allowed to remain. Always completely fill the head joints between adjacent masonry units. This may be done easily by completely buttering the end of the brick to be laid with mortar. Sometimes a shoved joint is made. This means the brick is shoved against the next brick. This leaves the head joint full of mortar.

When grout is poured into the grout cavity, it should be sufficiently fluid so that it will flow into all joints and around all steel reinforcement rods. Grout can be put into the space by either low-lift or high-lift grouting. Low-lift grouting consists of building only a few courses and then pouring in the grout. High-lift grouting consists of building the wall much higher and then pouring in a great quantity of grout at one time. However, this latter method could cause a "blow-out." The fluid weight may cause the separate walls to spread, which would mean that the entire structure would have to be rebuilt. Feeding small amounts of grout at one time allows the material to harden, and the danger of blow-out is lessened.

Always stir the grout before use to avoid having the aggregate separate. Grout should be poured with a spouted bucket and should not be allowed to splash onto the faces or tops of the brick. Because grout hardens more quickly next to the brick, the grout should be agitated immediately after it has been poured.

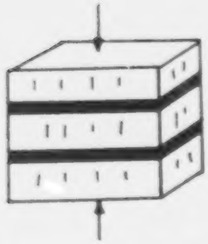


Figure 1. Compressive Stress

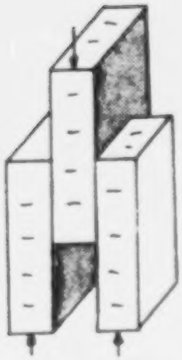


Figure 2. Shear Stress

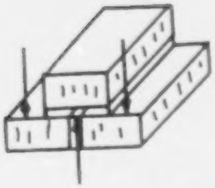
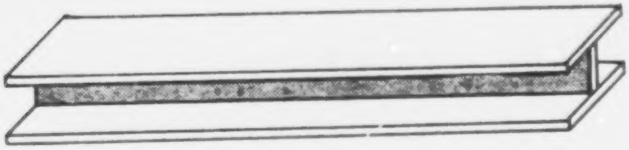
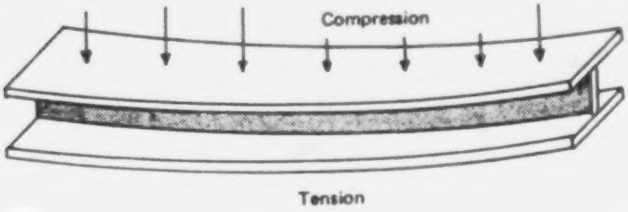


Figure 3. Tension Stress



Before Bending


Compression
Tension

After Bending

Figure 4. Stresses During Bending

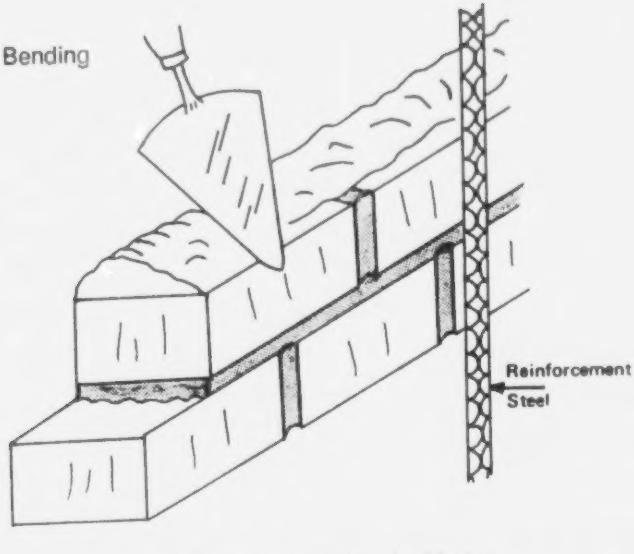

Reinforcement
Steel

Figure 5. Tapering the Mortar

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME____DATE___________

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Using Reinforcing Bars

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to understand the use of reinforcing bars.

REFERENCE: Student Information Sheet/Using Reinforcing Bars

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What forces are brick walls subjected to?

2. What makes up the live load of a structure?

3. What is the definition of stress?

4. What happens when compression stress is applied to a structure?

5. What type of stress usually occurs when wind blows against a wall?

6. Why is steel normally used in flexural members?

7. What type of brick is used for reinforced brick masonry?

8. When should vertical reinforcing steel be placed in the structure?

9. What may be affected when all mortar joints are not filled?

10. How may the brick worker prevent excess mortar from dropping into the grout space?

11. Name two methods of placing grout into the grout cavity.

12. What should not be allowed to drop into the grout space at any time?

13. How is a shoved joint made?

14. How can you avoid "blow-out"?

STUDENT INFORMATION SHEET

BRICKLAYING/STONE MASONRY

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Basic Construction Processes

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be familiar with basic construction processes used in bricklaying/stone masonry.

Selection of Bonds

Brick positions. The position in which a brick is placed in a structure has a great deal of effect upon both the strength and appearance of the finished product (figure 1). Bricks that are placed lengthwise on the wall with the longest edges parallel to the face of the wall are called **stretchers. Headers** are bricks that are placed at right angles to the stretchers or across the wall with the ends parallel to the face of the wall. **Solder bricks** are placed in a vertical position with the edges facing the front of the wall. **Sailor bricks** are placed in a vertical position with the faces of the bricks facing the front of the wall. A **shiner brick** is placed lengthwise on the wall with the face or width of the brick toward the front of the wall. A **rowlock** position is achieved when the brick is set on edge with the end toward the front of the wall.

Bond and joint terms. It is important to know the terms associated with the brick when it is placed into position. The **course** is one of the continuous horizontal layers of units (bricks) that is bonded with mortar (figure 2). A **wythe** consists of each continuous vertical section of masonry that is one unit in thickness (figure 3).

There are also three joint terms you should know (figure. 4). The **bed joint** is the horizontal layer of mortar on which a masonry unit is laid. The **collar joint** is the vertical, longitudinal joint between wythes of masonry. The **head joint** is the vertical mortar joint between ends of masonry units. This is sometimes called a cross joint.

Selection of the bond. When selecting a bond, consider both appearance and economy. Strength is not always a deciding factor as all types of bonds normally used will carry the expected loads. The type of bond usually depends on the type of brick, the color of the mortar, and the type of joint that is used. Different geometrical patterns are developed through the use of various bonds or combinations of bonds.

Colored Mortars

Colored mortar is sometimes used to add to the appearance of brick construction. Either all the mortar may be colored, or a deep rake between the brick is made, and colored mortar is placed in the outer edge of the joint.

Structural Bonds

The three main types of structural bonds are the overlapping or interlocking of masonry units, the use of metal ties that are embedded in connecting joints, and the adhesion of grout to adjacent wythes of brick. The overlapped bond uses variations of two basic methods of bonding. The English bond (figure 5) consists of alternating courses of headers and stretchers. The Flemish bond (figure 6) consists of alternating headers and stretchers in each course and arranging them so that the headers and stretchers in every other course appear in vertical lines. The stretchers are laid with the length of the wall and develop longitudinal bonding strength. At the same time, the headers are laid across the width of the wall, and this bonds the wall transversely. Most building codes require that masonry-bonded walls be bonded so that no less than four percent of the wall surface is made up of full-length headers. The distance between adjacent full-length headers should not exceed 24 inches either vertically or horizontally.

When masonry walls are bonded with metal ties, they may be used in both cavity-wall and solid-wall construction. Building codes usually permit the use of rigid steel bonding ties in solid walls. They normally require that the steel ties have a diameter of 3/16 inch and that they are spaced so that there is at least one metal tie for every 4 1/2 square feet of wall area. The vertical distance between ties should be not more than 18 inches and the horizontal distance not more than 36 inches. Ties that are in alternate courses must be staggered.

Another way of structurally bonding solidly and of reinforcing brick masonry walls is to pour grout into the cavity or collar joint between wythes of masonry. The grout core in reinforced masonry construction is also useful in containing and bonding the reinforcing steel. Grout may be defined as mortar with sufficient water added to allow the material to flow without segregation of the ingredients.

Pattern Bonds

Sometimes structural bonds may be used to create a pattern on the face of a structure. However, pattern usually refers to the arrangement of the texture or color that is used in the face. This way it is possible to secure several patterns in the same structural bond. Patterns may also be created by the method of handling the mortar joint or by the recession or projection of some of the bricks from the face of the structure.

The five basic structural bonds that are in wide use today and that create individual patterns are the running bond, common or American bond, Flemish bond, English bond, and stack bond (figure 7).

Running bond. The least complicated of the basic pattern bonds is the running bond, and it consists totally of stretchers. Because there are no headers, metal ties are normally used. This bond is used most commonly in cavity-wall construction and veneered walls of brick. However, sometimes it is used in facing tile walls where the bonding is accomplished by very wide stretcher tile.

Common or American bond. The common or American bond is a variation of the running bond in that it has a course of full-length headers at regular intervals. These headers are used to provide both structural bonding as well as pattern. With this bond, header courses usually appear at every fifth, sixth, or seventh course. When using the common bond, a three-quarter brick must start each header course at the corner.

Flemish bond. When the Flemish bond is used, each course of brick is made up of alternate stretchers and headers. The headers in alternate courses are centered over the stretchers in the intervening courses. There are several ways to vary the Flemish bond. Sometimes the number of stretchers between headers in each course is increased. If three stretchers alternate with a header, the resultant bond is called a garden wall because it was originally used in the construction of eight-inch garden walls. When two stretchers are used between headers, the result is a double stretcher garden wall. More stretchers may be used between headers when desired.

English bond. The English bond is composed of alternate courses of headers and stretchers. The headers are centered on the stretchers, and the joints between stretchers in all courses line up vertically.

Dutch and English corners. There are two ways of starting the corners in both the Flemish and English bonds (figure 8). The Dutch corner makes use of a three-quarter brick closure. The English corner may use a king or queen closure. When the queen closure is used, the two-inch, or quarter, brick is placed four inches back from the corner. Sometimes the English corner is constructed by using a beveled brick called a king closure.

Stack bond. The stack bond is a pattern bond that has aligned vertical joints and no overlapping units. It is usually bonded to the backing with rigid steel ties. When there are large wall areas or when the construction is load bearing, steel pencil rods should be placed in the horizontal mortar joints.

Color and texture. Sometimes patterns are arranged through the use of different colored bricks. Interesting designs may also be created through the use of projected and recessed units.

Mortar Bonds

Mortar serves many purposes. It seals and bonds the units together, allows for dimensional variations, reinforces, and provides a means of decoration. Finishing may be done by the trowel or tool method. When the troweled joint is desired, the excess mortar is either cut off or is struck and finished with the trowel. The tooled joint requires the use of other special tools to compress and shape the mortar to the desired finish.

Both the concave joint and V-shape joint are usually kept fairly small and are shaped by a steel jointing tool. These joints resist rain penetration and are practical in areas where rainfall is heavy. The weathered joint is more difficult to shape because it must be worked from below. It is thought to be one of the best troweled joints because it also sheds water very easily. The rough cut, or flush joint, is the easiest to accomplish because it is made by placing the edge of the trowel flat against the brick and cutting in any direction. The joint is not compacted, however, and a hairline crack will be left where the mortar is pulled away from the brick. This means that it is possible for water to seep into this crack. The struck joint is used quite often in ordinary brickwork and is made with a trowel. It does not shed water as well as some of the other types. The raked joint is made by removing the surface of the mortar while it is still soft, or uncured. It is very hard to make waterproof and is not recommended where heavy rain-falls, high winds, or freezing may occur.

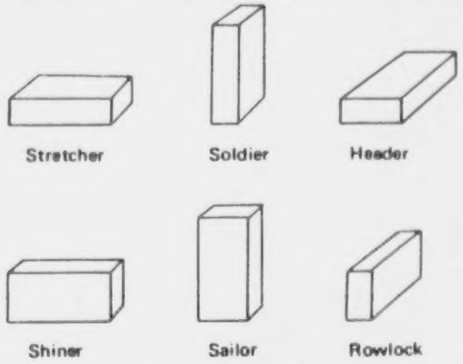

Stretcher
Soldier
Header
Shiner
Sailor
Rowlock

Figure 1. Brick Positions

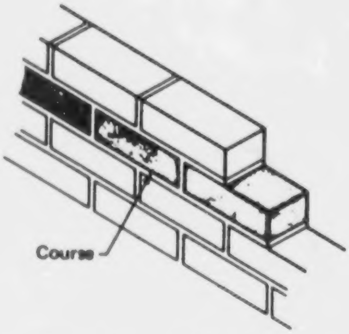


Figure 2. Brick Course

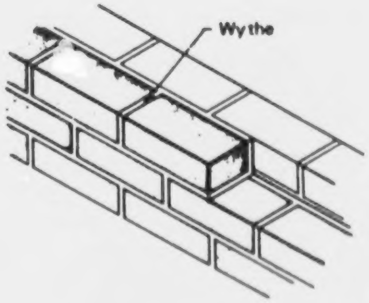


Figure 3. Masonry Wythe

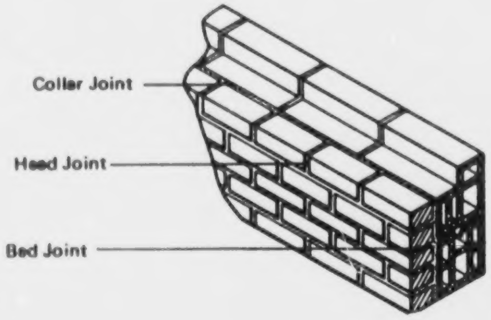

Collar Joint
Head Joint
Bed Joint

Figure 4. Masonry Joints

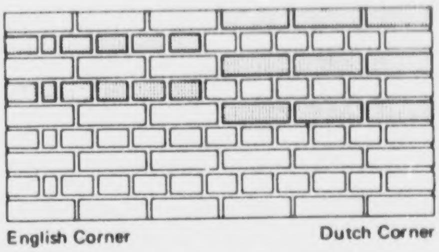

English Corner
Dutch Corner

Figure 5. English Bond

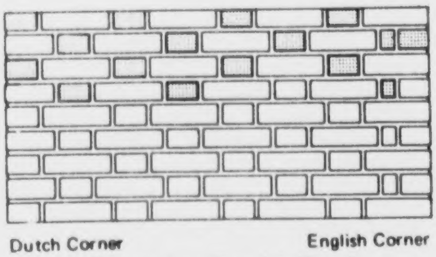

Dutch Corner
English Corner

Figure 6. Flemish Bond

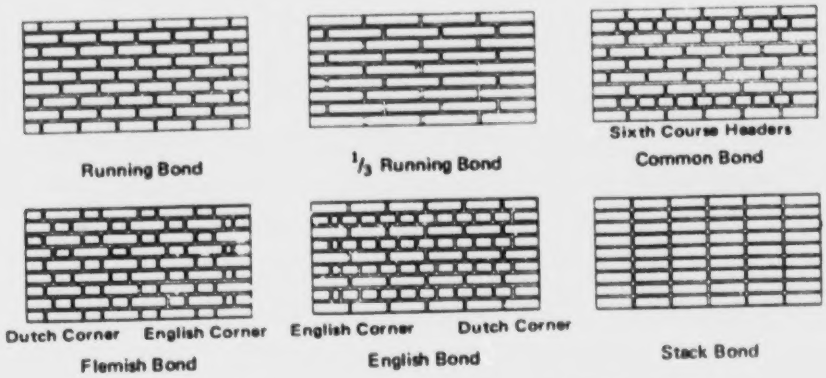

Running Bond
$^1/_3$ Running Bond
Sixth Course Headers
Common Bond
Dutch Corner
English Corner
Flemish Bond
English Corner
Dutch Corner
English Bond
Stack Bond

Figure 7. Common Structural Bonds

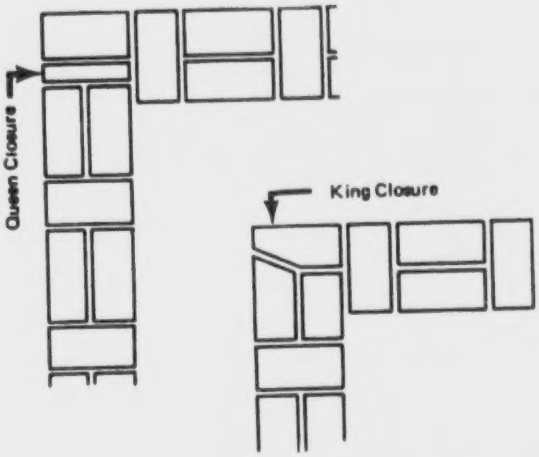

Queen Closure
King Closure

Figure 8. King and Queen Closures

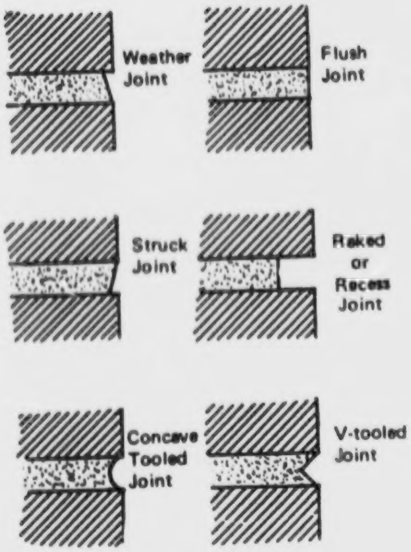

Weather Joint
Flush Joint
Struck Joint
Raked or Recess Joint
Concave Tooled Joint
V-tooled Joint

Figure 9. Types of Mortar Finishes

ASSIGNMENT SHEET

BRICKLAYING/STONE MASONRY

NAME____**DATE**______________

UNIT: Fundamentals of Bricklaying/Stone Masonry

TOPIC: Basic Construction Processes

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the fundamentals of bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be familiar with basic construction processes used in bricklaying/stone masonry.

REFERENCE: Student Information Sheet/ Basic Construction Processes

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What are stretchers?

2. What is a soldier brick?

3. Define course.

4. What is a collar joint?

5. What type of bond alternates courses of headers and stretchers?

6. How is grout used when structurally bonding solid and reinforced brick masonry walls?

4(3

7. List the five basic structural bonds that are commonly used today.

8. What two methods are used for finishing mortar?

9. What mortar joint is recognized as one of the best troweled joints?

10. What is a rowlock position of a brick?

11. What is a bed joint?

12. When the rough cut is used and the mortar is pulled away from the brick, what is sometimes left at the mortar line?

JOB SHEET

BRICKLAYING/STONE MASONRY

NAME____DATE________________

UNIT: Working in Bricklaying/Stone Masonry

NAME OF JOB: Preparing, Mixing, and Spreading Mortar

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will prepare, mix, and spread mortar.

TOOLS AND EQUIPMENT: Measuring cup, practice board (1"x6"x24"), mortar box, trowel, mortar stand, mortar hoe

MATERIALS: Partland cement, hydrated lime, sand, water

GENERAL INSTRUCTIONS: When working in bricklaying/stone masonry, you must learn to prepare, mix, and spread mortar. For the purpose of practice, you may wish to use type K mortar. Type K mortar has very low strength, is used only for interior work, will not support a load, and has a high content of lime and sand. Because of these qualities, it is often used for practice mix.

PROCEDURES AND/OR TASKS:

1. Locate the necessary tools, equipment, and materials required.
2. Follow the table below for the correct amounts of each mortar part.

PARTS BY VOLUME			
TYPE	PORTLAND CEMENT	HYDRATED LIME	SAND
M	1	1/4	2 1/2 to 3 times the total amount of cement and lime
S	1	1/4 to 1/2	
N	1	1/2 to 1 1/4	
O	1	1 1/4 to 1 1/2	
K	1	2 1/2 to 4	

3. Use a clean, dry mortar box.

4. Measure correct amounts of dry materials.

5. Place 1/2 of the sand needed into clean, dry mortar box.

6. Place other dry materials on top of the sand.

7. Place the remaining sand on top of the dry materials.

8. Using the mortar hoe, mix the dry materials and sand well.

9. Using the mortar hoe, move all of the mixture to one end of the box.

10. Add water to the empty end of the box.

11. Mix the dry mixture into the water.

12. Add water while mixing until mortar is the proper consistency.

13. Let mortar stand for five minutes.

14. Mix again.

    NOTE: To test for proper consistency, drag the tip of the trowel through the mortar. The "V" formed by the trowel should not slump, and the mortar surface should be smooth.

    CHECK POINT: Before proceeding further, have your instructor check your work.

15. Set practice board in place.

16. Set up mortar stand.

17. Place mortar on stand.

18. Grasp trowel loosely in hand at base of handle.

19. Re-mix mortar on stand.

20. Scoop-up a trowel full of mortar.

21. Place edge of trowel on top of practice board.

22. Dump mortar while dragging board (figure 1).

NOTE: Row of mortar on practice board should be about 2 1/2 inches wide and 2 inches deep.

23. Drag tip of trowel through top of mortar row (figure 2).

CHECK POINT: Before proceeding further have your instructor check your work.

24. Remove remaining practice mortar from mortar box/board and practice board. Place practice mortar in trash container.

25. Using clean water, wash the tools, practice board, mortar box/board, and hands.

26. Replace tools and equipment.

27. Clean area.

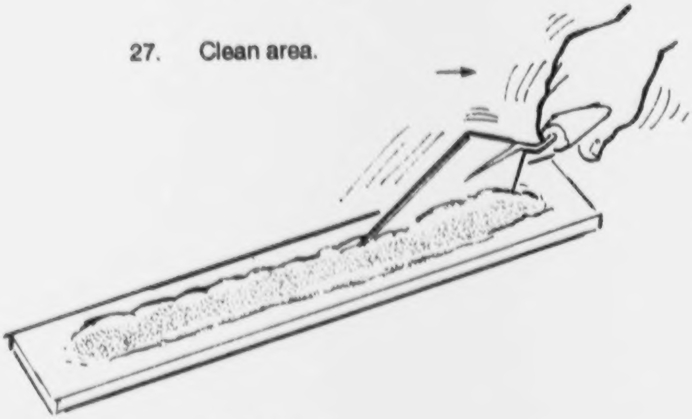


Figure 1.

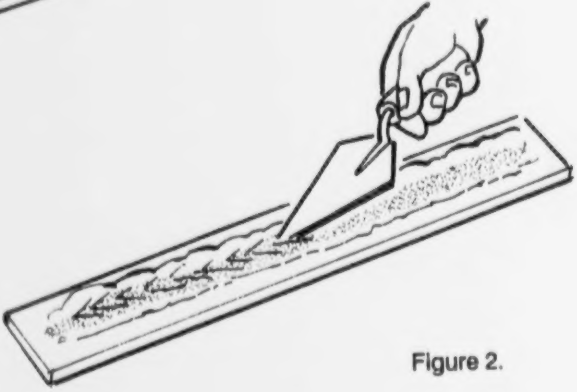


Figure 2.

JOB SHEET

BRICKLAYING/STONE MASONRY

NAME________________________________**DATE**________________

UNIT: Working in Bricklaying/Stone Masonry

NAME OF JOB: Cleaning Tools and Walls

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate cleaning procedures for masonry tools and walls.

TOOLS AND EQUIPMENT: Gloves, wooden paddle or scraper, wire brush, garden hose, nozzle, chisel, bucket, measuring cup, stiff fiber brush

MATERIALS: Clean water, brisodium phosphate, household detergent

GENERAL INSTRUCTIONS: Bricklaying/stone masonry tools should be cleaned with water immediately after they are used. Be sure to wash your hands carefully in order to remove concrete or mortar from your skin. One procedure for cleaning new masonry walls does not require the use of acids. You first wait until the mortar is completely set and cured and then begin the cleaning operation. Using the following steps, clean a small section of a brick wall.

PROCEDURES-AND/OR TASKS:

1. Wear gloves to protect your hands.
2. Using a wooden paddle or scraper, remove large particles of mortar from the wall. If necessary, use a wire brush or chisel to do this.
3. Using a garden hose, wash away all loose mortar and dirt.
4. Mix a solution of 1/2 cup of trisodium phosphate and 1/2 cup of house hold detergent dissolved in one gallon of clean water. Using a stiff fiber brush, scrub down the wall with the solution.
5. Using a high pressure nozzle on the garden hose, rinse off all cleaning solution and mortar particles.

6. Wash tools and hands thoroughly with clean water.

7. Clean area and replace tools and materials used.

JOB SHEET

BRICKLAYING/STONE MASONRY

NAME____**DATE**____________________

UNIT: Working in Bricklaying/Stone Masonry

NAME OF JOB: Constructing a Simple Brick Wall

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will construct a simple brick wall.

TOOLS AND EQUIPMENT: Practice board (1"x6"x36"), trowel, mortar stand, shovel, joint raker

MATERIALS: Bricks (7), mortar, water

GENERAL INSTRUCTIONS: Using the practice board as your first course of brick, prepare to lay a three course brick wall.

PROCEDURES AND/OR TASKS:

1. Prepare mortar as instructed in Job Sheet "Preparing,Mixing, and Spreading Mortar."

2. Set up mortar stand.

3. Place three or four shovels of mortar on stand.

4. Grasp trowel loosely in hand at base of handle.

5. Re-mix mortar.

6. Scoop up a trowel full of mortar.

7. Place edge of trowel on practice board.

8. Dump mortar while dragging trowel along the practice board (figure 1).

   NOTE: Row of mortar on practice board should be about 2 1/2 inches wide and 2 inches deep.

9. Drag tip of trowel through top of mortar row (figure 2).

10. Keeping the end of the brick even with the end of the practice board, lay and press brick into place in the center of the practice board.

11. Scrape excess mortar squeezed from bed with trowel.

12. Spread mortar left on the trowel on the inside end of the brick just laid.

13. Repeat steps 4-12 until four bricks have been laid.

14. When a four brick course has been laid on the practice board; begin again with step four. This time place the row of mortar on top of the row of brick.

15. Start the first brick of the third course at the center of the first brick on the second course (figure 3).

16. Repeat steps 4-12 until three bricks have been laid.

17. Using a pointing trowel, fill any exposed joints with mortar.

18. Use a jointing tool to make a raked joint finish (figure 4).

    NOTE: On a raked joint, mortar is raked out of joint to a depth of 3/8 inch using a wheel joint raker.

19. Clean all tools and equipment thoroughly.

20. Store tools and equipment properly.

21. Wash your hands.

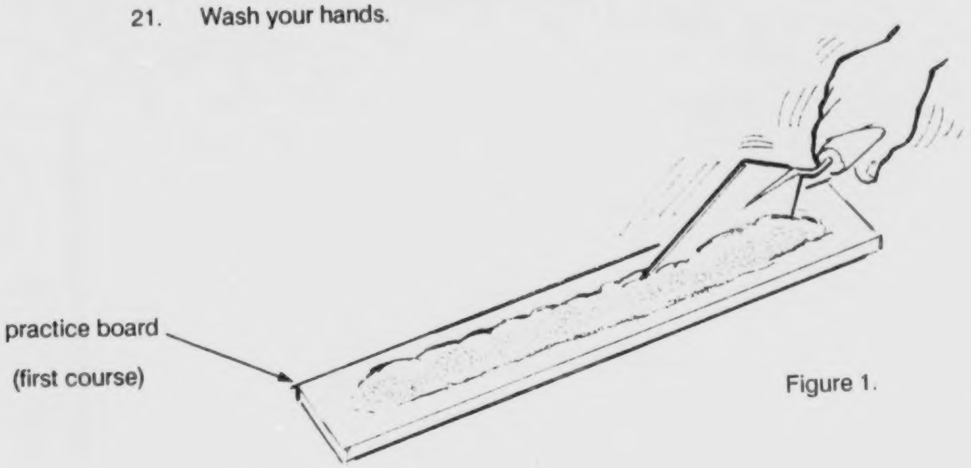


Figure 1.

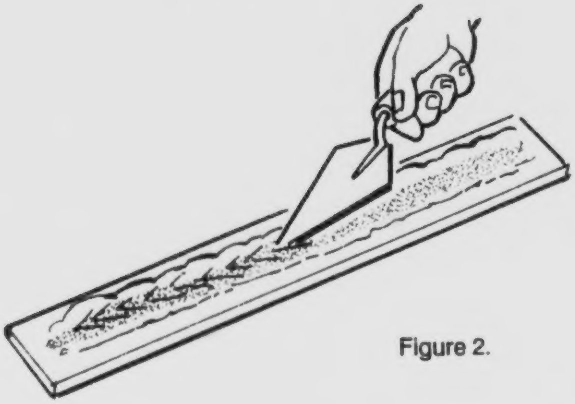


Figure 2.

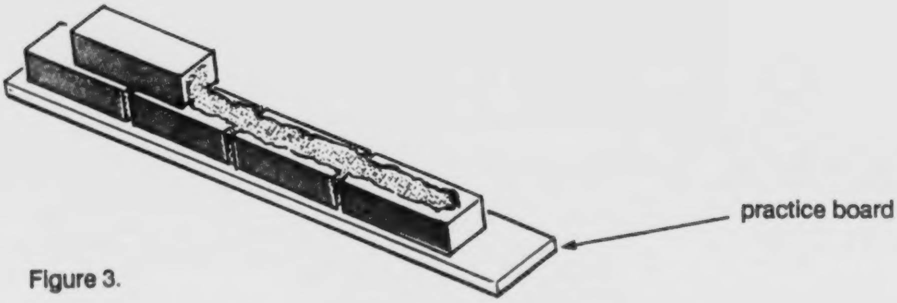

practice board

Figure 3.

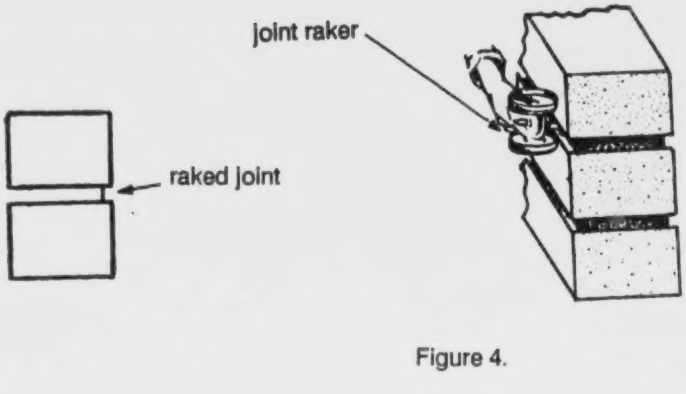

joint raker
raked joint

Figure 4.

JOB SHEET

BRICKLAYING/STONE MASONRY

NAME______________________________________**DATE**_______________

UNIT: Working in Bricklaying/Stone Masonry

NAME OF JOB: Constructing a Simple Block Wall

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in bricklaying/stone masonry.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will construct a simple block wall.

TOOLS AND EQUIPMENT: Practice board (1"x12"x6'), chalk line, mortar stand, shovel, mason's level, trowel, S-shaped joint raker

MATERIALS: Four concrete blocks (one corner block and three stretcher blocks,) mortar, water

GENERAL INSTRUCTIONS: When building a block wall, it is important that advance planning be done in order to insure that it will be a strong wall which looks good. Proper construction requires that joints be staggered or that adequate reinforcement be used.

PROCEDURES AND/OR TASKS:

1. Establish an outside wall line. You may use a chalk line in order to provide a straight line for the blocks. On your practice board, mark your outside wall line 1 1/2 inches from the edge of the board.

2. Lay out your first course of blocks without mortar to check layout. Allow 3/8 inch for each mortar joint. You may wish to mark the position for each block. When satisfied with the layout, move blocks aside.

3. Follow the same steps as used on job sheet "Preparing, Mixing, and Spreading Mortar" to mix your mortar.

4. Spread a full mortar bed on the practice board (the width of each block).

5. Use the trowel to furrow the mortar (figure 1).

6. Place the corner block in position.

NOTE: Lay concrete block with the thicker edge of the face up to provide a wider mortar bed.

7. Use the trowel to place mortar on the end of the block. This is called buttering. Stand three stretcher blocks on end and butter the end of the face shell (figure 2).

8. Lay each block along the wall line on the practice board. To place the blocks, push them downward into the mortar bed and sideways against the previously laid block (figure 3).

9. After you have laid four blocks, use a mason's level to align, level and plumb them.

NOTE: Be sure to tap on the block and not the level.

10. When the mortar is thumbprint hard, use an S-shaped jointer to tool the vertical mortar joints.

CHECKPOINT: Before proceeding further, have your instructor check your work.

11. Clean all tools and equipment thoroughly.

12. Store tools and equipment properly.

13. Wash your hands.

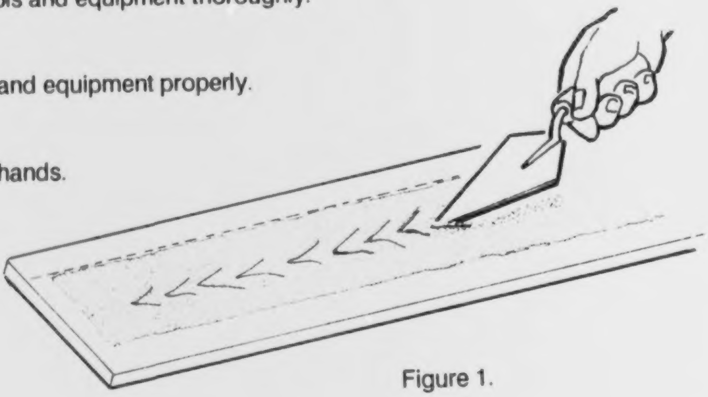
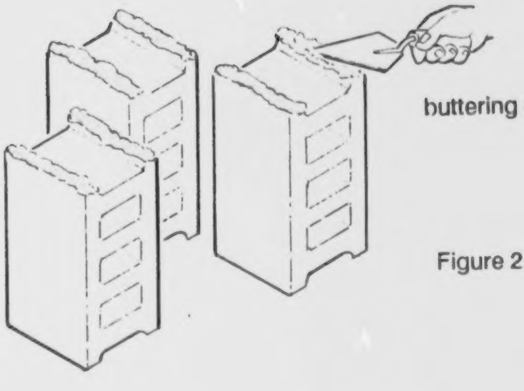


Figure 1.



buttering end of stretcher blocks

Figure 2.

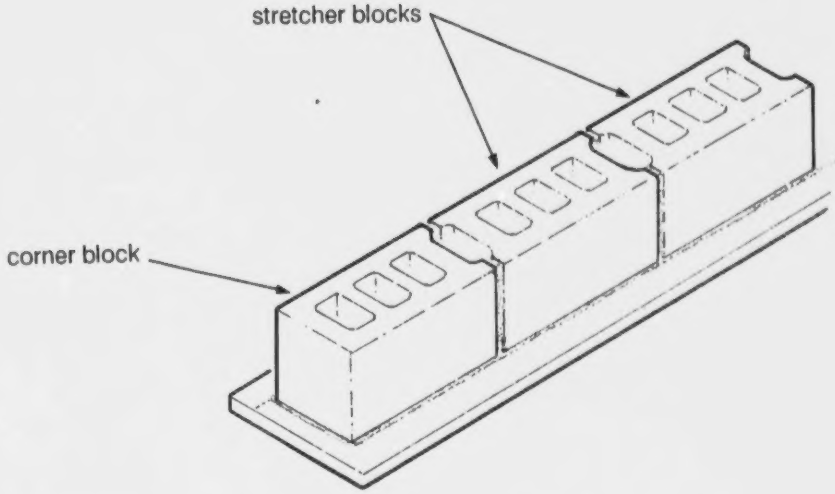

stretcher blocks
corner block
practice board

Figure 3.

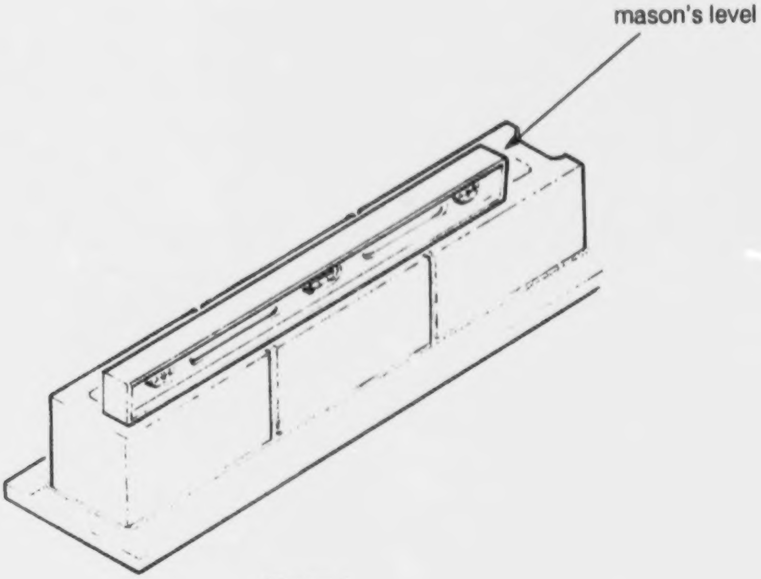

mason's level

Figure 4.

SECTION III

CARPENTRY

STUDENT INFORMATION SHEET

CARPENTRY

UNIT: Safety

TOPIC: Ladder Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. cite general rules to observe when using ladders;
2. describe safety measures to take when using leaning ladders; and
3. give safety measures to take when using stepladders.

General Ladder Safety

All ladders must be inspected at regular and frequent intervals. No ladder with rungs, treads, or cleats that are weak, broken, or missing should be used. A defective ladder that is no longer strong or safe to use should be taken out of service at once. Ladders should be finished only with transparent materials. Suitable transparent protective finishes, such as linseed oil, clear shellac, or varnish, should be applied. Paints conceal breaks, cracks, or other defects.

Use a ladder when you must climb. Chairs, boxes, or other elevating devices may cause accidents. When going up a ladder, always look up to make sure you will not bump your head. Do not work from a ladder that is in front of a door that may be opened against it. If you must be in front of the door, see that it is either locked or blocked.

Leaning Ladder Safety

When working on a structure of more than two stories, either separate ladders for climbing up and down or a single wide ladder divided by a center rail should be provided. Up and down sides of single ladders should be plainly marked up and down. Bases of ladders set up in passageways, driveways, or thoroughfares should be surrounded by barricades or guardrails.

A ladder should have secure underfooting and enough upper support. Tops of ladders should never rest against window sashes. Sometimes the top of a ladder must be set in a window opening in which a sash has been installed. Then the ladder should be placed against a 2-by-4 nailed across the opening, not against the sash. To prevent the foot of the ladder from slipping, the distance between the foot of the standing ladder and the base of the vertical structure it rests against should not exceed one quarter of the ladder's full length.

If the ladder rests against an over-hanging roof or structure, this distance must measure from a mark on the ground at a point perpendicular to the overhang. Back clearance behind all rungs should be sufficient to allow for a good grasp. A minimum of 6 inches is recommended.

When climbing up or down, always face the ladder and use both hands. Materials that cannot be carried up or down without leaving both hands free should be sent on a line or hoisted mechanically. Running up or sliding down ladders is dangerous. Workers should be careful of greasy or slippery shoe soles. These could easily slip or leave slippery rungs for others.

Liquid materials such as paint should be hung on ladder rungs in containers fitted with hooks or handles. A person should never reach more than one arm's length when working on a ladder. It is dangerous to carry loose tools in your pocket when climbing or working on ladders because they might fall on someone below.

Only in unavoidable emergencies should ladders be used during storms or high winds. If a ladder must be used under such circumstances, it should be securely tied in position. If a ladder must be left standing outside for a long time, it should be securely anchored at both top and bottom to prevent it from being blown down.

Step Ladder Safety

Always open or spread stepladders fully. Be sure spreaders are in place and locked into position before you attempt to climb the ladder. Tools left on top of stepladders are liable to fall and injure someone. Do not stand on the top step of a stepladder. You can easily lose your balance (see figure 1).

Always keep your weight evenly distributed on the ladder for good balance. See that all four legs are stable against the ground or floor. It is sometimes necessary to block a leg on uneven ground, but see that the block is large enough to remain stable when weight is applied to the ladder. Also take care in storing the stepladder. If it leans against another structure, it can easily be knocked down.

ASSIGNMENT SHEET

CARPENTRY

NAME:______________________________________**DATE:**_______________

UNIT: Safety

TOPIC: Ladder Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. cite general rules to observe when using ladders;
2. describe safety measures to take when using leaning ladders; and
3. list safety measures to take when using stepladders.

REFERENCE: Student Information Sheet/Ladder Safety

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. When should a ladder be withdrawn from service?

2. Why should ladders be finished only with transparent materials?

3. Name three suitable materials for coating ladders.

4. How should the sides of divided ladders be marked when used for work on structures of more than two stories?

5. What safety practices should be observed when ladders are set up in passageways, drive?

6. What safety measures should be observed when ladders are set up where doors can be opened against them?

7. How should a ladder be set in a window opening where a sash has been installed?

8. What safety measures should be observed when a ladder is left standing outside for a long period of time?

9. In what direction should a person face when climbing up or down a ladder?

10. Why is it dangerous to carry loose tools in a pocket when climbing or working on a ladder?

11. What is the maximum distance that a person should reach when working on a ladder?

12. How should liquid materials be supported on ladders?

13. How far out should the foot of a ladder be placed, compared to the ladder's extended height?

14. When working on a ladder, how should tools be raised or lowered?

15. Why should you avoid standing on the top step of a stepladder?

JOB SHEET

CARPENTRY

NAME:______________________________ **DATE:**______________________

UNIT: Safety

NAME OF JOB: Setting Up a Stepladder

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to correctly set up a stepladder.

TOOLS AND EQUIPMENT: Stepladder

MATERIALS: No materials are required.

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Open stepladder fully.
2. Make sure spreaders are in place and locked into position.
3. Be sure that all four legs are stable against the floor.
4. Have your instructor check the stepladder.
5. Replace the stepladder.

STUDENT INFORMATION SHEET

CARPENTRY

UNIT: Introduction to Careers in Carpentry

TOPIC: Careers in Carpentry

UNIT OBJECTIVE: After completion of this information sheet, the student will be able to understand employment/career opportunities and training requirements for carpentry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. describe various types of jobs performed by carpenters;
2. name locations where carpenters normally find employment; and
3. name the advantages and disadvantages of carpentry as a trade.

Type of Work

Carpenters construct, erect, install, and repair structures and fixtures of wood, plywood, wallboard, and other materials. They use both hand tools and power tools. They must comply with local building codes and be able to read blueprints, sketches, and building plans. This enables them to learn the types of materials required, the dimensions of the structure, and thelocation of structural parts.

Carpenters select the specified types of lumber, fasteners, insulation, roofing or other materials. They prepare layouts using rules, squares, and builder's levels. They mark lines on materials for cutting and assembling with pencil, chalk, or a marking gauge. They also shape materials to prescribed measurements with saws, chisels, and planes.

Carpenters also assemble, cut, and fasten materials together with nails, screws, bolts, dowel pins, or glue. They verify trueness (whether the structure is plumb, level, or square) of the structure with a plumb bob and carpenter's level. They erect framework for structures, lay subflooring, build stairs, and lay out and install partitions and cabinetwork. Most of the work that is done with a hammer is done by the carpenter.

Carpenters cover subfloors with building paper to keep out moisture. They lay hardwood, parquet, and wood-strip-block floors by nailing floors to the subfloor or cementing them to a mastic or asphalt base. They apply shock-absorbing, sound-deadening, and decorative paneling to ceilings and walls. They fit and install prefabricated window frames, doors, door frames, weather stripping, interior and exterior trim, and finish hardware, such as locks, letter drops (mail drops), and kickplates.

Sometimes carpenters construct concrete forms and pouring chutes, erect scaffolding and ladders for assembling structures above ground level, and weld metal parts to steel structural members.

Because of the wide scope of work performed in the trade, some carpenters specialize in a particular type of work, such as acoustics, bridges, or shipbuilding. Acoustical carpenters install acoustic panels on ceilings and walls. Bridge carpenters repair wooden railroad bridges, trestles, and tunnel supports. Ship carpenters fabricate and repair structural woodwork and wooden gear on ships.

Of course, many other fields of specialization exist. For example, carpenters who specialize in residential structures may be either finish carpenters or rough carpenters. Rough carpenters are responsible for framing; erecting studs and partitions; and installing floor joists, rafters, and ceiling joists. They also build forms for concrete, make scaffolds and chutes, and sometimes do roofing work. Finish carpenters are responsible for installing paneling, molding, finish flooring, trim, and stair work. They also install doors, windows, hardware, and shelving. They sometimes construct cabinets and other built-in furniture. Experienced carpenters are usually qualified to do both rough and finish carpentry.

Places of Employment

There were over a million carpenters employed in the United States in the 1980s, and about 20 percent were self-employed. A majority of carpenters work for building contractors and homebuilders who erect new buildings and other structures. They may also alter, remodel, or repair structures. Most other carpenters work for manufacturing firms, utility companies, or government agencies.

Carpenters work all over the country and are not as concentrated in any particular geographic area as other construction occupations.

Qualifications and Advancement

Most training authorities recommend the completion of an apprenticeship program as the best way to learn carpentry. A large number of workers in this trade, however, have acquired their skills without a formal training program. Examples are carpenter's helpers.

Apprenticeship applicants are generally required to be at least 17 years old. A high school education or its equivalent is desirable. Good physical condition, a sense of balance, and no fear of heights are important assets. The apprentice should also have good manual dexterity and the ability to solve arithmetic problems quickly and accurately.

The apprenticeship program usually consists of 8,000 hours (four years) of on-the-job training and a minimum of 144 hours of related classroom instruction each year. During the apprenticeship period, apprentices learn elementary structural design and become familiar with the common systems of frame and form construction. They learn to use, care for, and safely handle the tools, machines, equipment, and materials used in the trade. They also learn how to build forms for setting concrete, to do framing and outside and inside finishing work, to fit hardware, to hang doors and set windows, and to lay out materials. Apprentices receive related classroom instruction in drafting and blueprint reading, in the mathematics applicable to layout work, and in the use of woodworking machines. Because the carpenter's work is basic to the construction process, the apprentice carpenter learns, both in the classroom and on the job, the relationship of carpentry to other building trades.

Hourly wage rates for apprentices usually start at about 50 percent of the journeyman (experienced worker) rate. These rates increase by about five percent in each six-month period until 85 to 90 percent of the journeyman rate is reached during the last period of apprenticeship.

It is important for young people interested in entering the carpentry trade to get well-rounded training provided in apprenticeship programs. Increasingly, technical innovations are affecting carpentry skills. Carpenters with such training have highly favorable, long-range job prospects. They are in much greater demand and have better opportunities for advancement than tradespeople who can do only the relatively simple, routine types of carpentry work.

For the carpenter with ability and initiative, job progress can be rapid. After becoming a journeyman, the carpenter may advance to the position of carpenter foreman, then to job superintendent, and on to the highest position, general superintendent. Carpenters usually have greater opportunities than workers in other building trades to become general superintendents since carpenters are familiar with the entire construction process. Also, self employment in carpentry is higher than in most other building trades. Some self-employed carpenters become contractors who employ other journeymen.

Employment Outlook

Job opportunities for carpenters should be good during the next ten years. Growth in population and in industry should lead to a demand for more houses and other buildings. However, the construction industry is sensitive to the economy. This means that the number of job openings may vary from year to year. There are so many carpenters in the construction industry that replacement needs are usually high. Replacements fill the positions of carpenters who retire, die, or leave their jobs for other fields.

Earnings and Working Conditions

The wages of the journeyman carpenter vary from year to year. Current hourly wages paid to carpenters range from about $5.50 to $15.00. This is about twice the average wage for production and nonsupervisory workers in private industries, except farming. Because of occasional layoffs due to poor weather or shortages of materials, annual salaries do not reflect the hourly wages. Hourly wages for apprentices usually start at about half that paid to experienced carpenters.

Carpentry is an active career field and sometimes requires strenuous work. However, great physical strength is not necessary. Carpenters may be required to climb, stoop, squat, or stand. They also risk injury from slips or falls, cuts from sharp or rough materials, and from the use of electrically powered equipment. Back injury is the most common type of injury for carpenters. Carpentry is mainly creative, vigorous work, and usually takes place outside. Usually, frequent changes in work locations occur.

A large number of carpenters are members of the United Brotherhood of Carpenters and Joiners of America.

Personal Requirements

Since carpenters do not work alone, they must meet certain personal requirements to complete a job successfully. They must cooperate with cement finishers, plumbers, electricians, steelworkers, bricklayers, and a variety of other workers. They must also be able to work with other journeymen, apprentices, and supervisors. They must be able to adjust quickly to working situations in order for other workers to do their jobs faster or more easily.

Carpenters must also be able to produce a structure that is both sturdy and neat in appearance. Carpenters must develop safe, uniform, and timesaving work habits. A little extra personal adjustment will make the job easier for themselves and their fellow workers.

Where to Go for More Information

For further information on carpentry apprenticeships or other work opportunities in this trade, questions may be directed to local carpentry contractors; a local unit of the United Brotherhood of Carpenters and Joiners of America; a local joint union-management apprenticeship committee; the nearest office of the state apprenticeship agency; or the Bureau of Apprenticeship and Training, United States Department of Labor. Also the local office of the state employment service may provide information about the Manpower Development and Training Act, apprenticeships, and other programs with training opportunities. Some local employment services screen applicants and give aptitude tests.

For general information on apprenticeship in the carpentry trade, contact:

© Associated General Contractors of America, Inc., 1957 E. St. NW, Washington, DC 20006

© United Brotherhood of Carpenters and Joiners of America, 101 Constitution Ave. NW, Washington, DC 20005

ASSIGNMENT SHEET

CARPENTRY

NAME:____**DATE:**_______________

UNIT: Introduction to Careers in Carpentry

TOPIC: Careers in Carpentry

UNIT OBJECTIVE: After completion of this information sheet, the student will be able to understand employment/career opportunities and training requirements for carpentry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. describe various types of jobs performed by carpenters;
2. name locations where carpenters normally find employment; and
3. name the advantages and disadvantages of carpentry as a trade.

REFERENCE: Student Information Sheet/Careers in Carpentry

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What information can a carpenter gain from reading blueprints, sketches, and building plans?

2. List three areas of specialization for a carpenter.

3. What two types of carpenters may work on a residential structure?

4. What type of carpenter is responsible for installing hardware in a residential structure?

5. In what type of construction are most carpenters employed?

6. How many carpenters were employed in the United States in the 1980s?

7. How old must a person be to enroll in a carpentry apprenticeship program?

8. What is the recommended time for completing an apprenticeship in carpentry?

9. How do the starting wages of apprentices compare to those of journeymen?

10. What job advancement is possible for the journeyman carpenter?

11. Why are advancement opportunities better for carpenters than other workers in the building trades?

12. What are some of the disadvantages found in the carpentry trade?

13. What are some of the advantages found in the carpentry trade?

14. What organization do many carpenters join?

15. Name several other tradespeople with whom the carpenter will be working.

STUDENT INFORMATION SHEET

CARPENTRY

UNIT: Introduction to Careers in Carpentry

TOPIC: House Planning

UNIT OBJECTIVE: After completion of this information sheet, the student will be able to understand employment/career opportunities and training requirements for carpentry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to describe duties performed by the carpenter other than actual carpentry.

The Carpenter's Responsibilities

Carpenters are responsible for more than the mere construction of a residential or commercial structure. They must be able to make plans, set up building procedures, and advise the homeowner and other tradespeople. Journeymen carpenters should be able to advise their contractors, foremen, or superintendents on materials to use, timesaving methods, or available personnel for certain jobs. Carpenters are close to the job and are usually aware of problems as they arise.

Carpenters should be able to answer questions the homeowner may have. Why do certain changes weaken a house? How will small changes improve the looks of the home? Carpenters must be very careful in this role, however. Any hint of incompetence in reference to the contractor, architect, or others involved in the construction project can hurt their relationship with the home buyer.

Carpenters should have an interest in each of their construction projects. They are the specialists, and their interests and suggestions will usually be accepted with appreciation. They should consider each project as a new challenge and exercise their ingenuity in offering advice.

Home Location

When purchasing a home, many buyers are either uninformed about the importance of a location or careless in examining this vital part of their purchase. If carpenters become contractors, they will help buyers to make this selection. They will advise them on homesites. If a buyer already owns lots, carpenters may suggest one of them for the buyer's particular need.

Careful consideration should be given to a buyer's family. If a buyer has children, the distance from schools and recreational facilities is important. Distance from work must also be considered.

A careful inspection of surroundings should be made. Is the location under an aircraft landing pattern or near an approach? Is a city dump, sewage disposal plant, or industrial plant nearby? Is the homesite on high ground in case of flooding? If the lot is on a hillside, can erosion be controlled? These and many more conditions must be considered.

Carpenters, in addition to the homeowner or contractor, have a responsibility to help in this selection. The homeowner will appreciate these efforts and will usually recommend the carpenter or contractor to other future homeowners.

Title and Survey

Before carpenters begin building, they should be sure that the title to the land is clear. If the home buyer or person other than the builder has purchased the land, the carpenter or contractor should have a lawyer draw up a mechanic's lien. This should be signed by the owner and the builder. It is a safeguard for both parties since one party cannot assume ownership of both house and land until the terms of agreement have been met.

A lawyer should inspect the property title to see that there are not mortgages, liens, delinquent taxes, or other things that might threaten legal ownership later. Property should be surveyed before construction begins. In a few instances, carpenters have either built on the wrong lot or placed the house over a boundary line. This kind of mistake may cause months of legal problems. However, most cities require surveys of property before a building permit is issued.

Utilities

The owner should check to see that utilities are available for the home. Also the carpenter or contractor should arrange during the planning stage for water and electricity to meet building needs. Much construction today relies on power equipment that requires electricity. Water is also necessary for concrete work.

The homebuyer may decide to connect pipes to a sewer system or to connect to a septic tank system. In either case, contractors or carpenters must know the drainage requirements before they can begin work. They must know the soil density if they are to install feeder lines to a septic tank.

Zoning Laws and Building Codes

City governments establish zones to reserve certain sections of a city for certain purposes. Most cities have different zoning categories such as industrial, commercial, apartment, and residential. Laws, ordinances, and building codes governing a zone may regulate the height of a structure and the distance allowed between a structure and a street or boundary line. They may also specify allowances on the use of glass and regulate plumbing, electricity, gas lines, sewage systems, and even fencing on the property.

Carpenters or contractors should be familiar with all zoning and building requirements in the area where they work. They should be certain that their structures comply with local regulations. By studying all regulations before they begin each new structure, they will avoid many difficulties.

ASSIGNMENT SHEET

CARPENTRY

NAME:______________________________________**DATE:**_______________

UNIT:	Introduction to Careers in Carpentry
TOPIC:	House Planning
UNIT OBJECTIVE:	After completion of this information sheet, the student will be able to understand employment/career opportunities and training requirements for carpentry.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will describe duties performed by the carpenter other than actual carpentry.
REFERENCE:	Student Information Sheet/House Planning
DIRECTIONS:	Read and answer each of the following questions in the space provided.

1. On what should journeymen be able to advise their contractors, foremen, or superintendents?

2. Why must the carpenter be cautious about making recommendations to the home buyer?

3. How should the carpenter consider each new job?

4. What conditions should be considered in the location of a home?

5. When should a mechanic's lien be drawn up?

6. Why should a lawyer inspect the title to the property?

7. What is not issued in most cities until after a survey is made?

8. What utilities will the carpenter need before construction begins?

9. Name four zoning categories that most cities use.

10. What are some of the areas in which building codes regulate house construction?

STUDENT INFORMATION SHEET

CARPENTRY

UNIT: Being Your Own Boss

TOPIC: Building Contractors and Types of Construction

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will:

1. explain the forms or types of businesses that may be organized and
2. discuss in what types of construction the building contractor may be involved.

Types of Organizations

The building contractor can set up a business in several different way. A **sole ownership** (or proprietorship) is the form used by most building contractors. The full responsibility for the company rests on one individual. No formal documents or agreements are necessary, and business and personal income may be the same for tax purposes.

A **partnership** agreement consists of individuals sharing responsibilities, liabilities, work, and profits. Many of these arrangements combine the building expertise of one person with the management abilities of another. A limited partnership usually consists of one person supplying the capital and the other person running the business.

A **corporation** involves more legal documents but gives tax liability advantages. Business and personal income taxes are separated, which allows for tax advantages. If losses occur in a corporation, the owner or owners are liable for only a part of those losses. Capital can also come from stockholders. An attorney should be retained to draw up the legal documents.

Construction Specialities

Building contractors specialize in one particular type of construction. It is too difficult to handle every building job that comes along.

Speculative Building. These contractors are sometimes called builder-developers. They have no contact with a person or firm during the building operation. They build first, then try to find a buyer. These structures, whether houses or buildings, may be easier to construct but may involve a great deal of risk. When loan money is limited or interest rates are high, the builder may be caught with one or more structures that will not sell.

The speculative builder usually buys underdeveloped land, subdivides the property, and builds streets and curbs. There can be a great deal of profit in this type of construction if it is in a desirable location and financing is available. Some builders do their own selling, while others use real estate brokers.

The speculative builder must have a substantial amount of money or be able to borrow a large amount for long periods of time. There must also be a certain amount of balance between the building and selling of the structure. If too many units are built during a buying lull, the contractor will have a large amount of capital tied up. If interest is being paid on the unsold units, profits are soon used up. For this reason, building contractors must keep a close watch on the local economy.

Custom Building (Contract Building). A custom builder is involved in construction for a particular person, persons, or firm. Contracts are drawn up containing certain specifications. The planning stage is difficult. Building contractors must be sure that every single detail has been covered to the customer's satisfaction before construction begins. Overlooked details or specifications can prove costly once construction has begun.

Custom building is not as costly as speculative building since the structure is paid for as soon as it is finished. Most wholesalers and suppliers allow enough time for completion of the project before making money demands. Since the customer has already secured financing before the project begins, there is little delay on payment. The largest unsecured cost is the time and effort spent on making estimates and submitting bids. This can be figured into the total cost if the customer goes ahead and allows the contractor to do the building. If the initial estimate is based on floor plans drawn up with the builder, the builder may charge for these plans, whether the customer accepts the bid or not. If so, the customer keeps the plans to take to other contractors for their bids.

Some financial institutions pay the contractor in building stages. A percentage of the total cost may be paid after the foundation is poured, another percentage paid after the structure is roughed in, and the balance paid on completion. Other institutions may only make one payment after completion.

Home Repair and Remodeling. Many new building contractors start their own businesses by repairing existing structures. This takes very little capital, and a reputation can be established while equipment and materials are being accumulated. Most large contractors are not interested in doing small repairs. This means there are many opportunities for the starting contractor. Since repair and remodeling work is short-lived, the contractor must plan far ahead and must depend on contact with many people. Word-of-mouth advertising is very important. The contractor must have developed good relationships with previous customers.

ASSIGNMENT SHEET

CARPENTRY

NAME:______________________________________**DATE:**____________

UNIT: Being Your Own Boss

TOPIC: Building Contractors and Types of Construction

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will

1. explain the forms or types of businesses that may be organized and
2. discuss in what types of construction the building contractor may be involved.

REFERENCE: Student Information Sheet/Building Contractors and Types of Construction

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What form of business is used by most building contractors?

2. What do individuals share in a partnership agreement?

3. What is a limited partnership?

4. What incomes are separated in a corporation?

5. Who should draw up the legal documents for a corporation?

6. Who are speculative builders?

7. What type of building involves the greatest risk?

8. What is custom building?

9. Why is the planning stage for a custom builder difficult?

10. What is the largest unsecured cost to the custom builder?

11. How do financial institutions pay the builder?

12. How do many new building contractors start their businesses?

STUDENT INFORMATION SHEET

CARPENTRY

UNIT: Being Your Own Boss

TOPIC: Setting Up a Construction Business

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will identify entry-level procedures, planning processes, and terms needed to open a business.

Licenses and Permits

Many states require that the building contractor obtain a license before beginning a structure. Usually an application must be submitted to the state application board. This board will consider the applicant's work experience, technical training, financial statement, and other factors before issuing a license.

Some states also require a seller's permit. This is primarily for those contractors who sell leftover materials, used materials from repaired structures, and occasional pieces of equipment.

A building permit is required for each structure that is to be built. Zoning laws must be taken into account when this permit is obtained. Structures must be built at a certain distance from property lines or from the street. Other restrictions apply to utility lines, sewer systems, size of structure, type of material used, and use of the proposed structure. Of course, other restrictions control the size of the electrical wiring, plumbing materials, and roofing shingles.

Taxes

The building contractor must obtain an employer's identification (EI) number from the Internal Revenue Service. This number is used on forms submitted with social security and federal income taxes that have been withheld from employees' salaries.

Contractors in states with sales tax laws must also submit sales taxes periodically. Sales tax laws concerning the construction industry vary from state to state.

The business must pay federal unemployment taxes if it has paid wages of $1,500 or more in any calendar quarter and has had one or more employees at least some portion of one day in each of 20 or more calendar weeks. The basic tax rate is 3.2 percent of the first $4,200 of taxable wages received by each employee. The actual rate to pay is much less because the federal government gives credit for unemployment taxes that are paid to the state government.

State unemployment taxes are usually based on the taxable wage base of a quarter. The rate of the tax charged is also usually determined by the employee's unemployment experience. In some states the worker is also assessed through payroll deductions.

Some counties, towns, and cities impose other taxes. These include real estate taxes, personal property taxes, taxes on gross receipts of businesses, and unincorporated business taxes.

Insurance

Building contractors are required to purchase a minimum amount of insurance. This is designed to protect the property owner, the public, and the company from losses. All subcontractors must also be insured.

Worker's compensation covers liability if a worker is injured on the job. Some coverages also include driving to and from work.

General liability is most important to the building contractor as it insures against any claims made by the public in case of injury while on the contractor's property.

Property insurance protects the contractor's property and equipment while a building is under construction. The coverage includes damages from fire and vandalism, which are the most common types of losses.

Bonds

Bonds are similar to insurance in that they protect the contractor against defaults by the subcontractor or the potential owner against defaults by the contractor. Bonds are usually required when financing is obtained from savings and loan companies, banks, or insurance companies. Bonds are hard to obtain by new builders.

A contract bond guarantees the completion of the project and payment of all workers, material suppliers, and subcontractors. A payment bond only guarantees that all workers, material suppliers and subcontractors will be paid. A performance bond guarantees completion of the job. If the job is not completed, the bonding company either has someone else complete it or pays an equal amount of money.

Liens

Lien laws are set up by states to ensure payment for goods to parties involved in the building process. Two methods are used to see that these payments are made.

The mechanic's lien is used on private property and is recorded in the county where the property is located. If a building contractor builds a house on another person's property but then the property owner refuses to pay for it, the contractor has a lien against the land.

A stop notice freezes construction funds held by the owner or lender until a suit is filed or money claims are covered.

Contracts

No construction should start without a binding contract. This is an agreement between the building contractor and the potential owner. A contract should contain the price of the completed project, terms of payment, services and specifications, construction time, liabilities, and guarantees.

Contracts are normally either the lump-sum or the cost-plus. A lump-sum contract specifies that the building contractor will be paid a certain amount after completing the job. Even if the job costs more than the contractor had originally figured, the owner still pays this specified price.

A cost-plus contract specifies that the owner is to pay certain construction and labor costs in addition to a certain dollar figure or percentage added for the contractor's profit.

Financing the Company

Few contractors can begin a business without acquiring additional capital. How much capital is needed depends on the type of contracting to be done, the equipment that must be purchased, the number of employees that will be hired, the size and staff of an office, and the amount needed for the builder's living expenses.

Sometimes the builder draws up a contract with progress payments coming from the owner at certain stages. This means the builder does not have to keep a backlog of money or go to a lending institution for loans during construction.

Large jobs or speculative building entails a large outlay of money, and loans must be sought. The builder must build a good reputation for dependability as soon as possible so that the risk factor to the lending institution is less.

The builder with sufficient capital can pay cash for materials and labor, thereby avoiding the payment of interest on borrowed money. Sometimes cash discounts are allowed on materials. With sufficient cash on hand, the builder can invest in equipment to save time and money.

The lending institution usually requires certain information before considering a loan to the builder. This usually consists of the design of the construction project with plans, specifications, location, and all other details. The lending institution also requires a cost breakdown of land costs, selling price, overhead, and expenses for the job. A preliminary title report is necessary to show that the property is clear of liens or easements. The lending institution must also have a complete financial statement from the builder. Sometimes it asks for a personal resume if it has not done business with the builder before.

Offices

A large company must have an office or offices to keep up with all the necessary paperwork. Smaller contractors may work out of their homes. In this case, someone must always be near the phone to handle business calls. Many contractors now use timesaving two-way radios. The base unit is installed in the home or in the office. The contractor or other workers in the field make contacts through the base unit. Information is then relayed to other workers, the contractors, or to other parties. Phone calls may be made to a supplier and the information given to the person on the job. This way, time-consuming trips to various places do not have to be made.

Equipment

The building contractor must have a certain amount of equipment to successfully operate a business. One or more pickup trucks are necessary for every contractor. Power equipment, such as table or radial arm saws, jointers, portable drills, portable circular saws, saber saws, and a variety of hand tools are necessary. Ladders, hoists, land-leveling equipment, and chain saws may be necessary. Surveying instruments and concrete mixers are sometimes needed by the contractor. Large companies may keep plumbers, electricians, and painters in their labor force. If so, equipment related to these trades must be kept available.

Personnel

When the contractor goes into business, he or she needs a good labor force. Contractors usually have friends who are good in their work and want to get in on "the ground floor" of a new business. Workers must be carefully selected. Starting a construction business with unreliable help can mean instant failure. Be sure you have enough employees. An understaffed company office or too few workers at the job site, soon makes scheduling impossible.

ASSIGNMENT SHEET

CARPENTRY

NAME:____________________________________**DATE:**__________

UNIT:	Being Your Own Boss
TOPIC:	Setting Up a Construction Business
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will identify entry-level procedures, planning processes, and terms needed to open a business.
REFERENCE:	Student Information Sheet/Setting Up a Construction Business
DIRECTIONS:	Read and answer each of the following questions in the space provided.

1. What is required on an application for a building contractor's license?

2. What laws must be taken into account when a building permit is obtained?

3. Where does a building contractor obtain an employer's identification number?

4. Where is the employer's identification number used?

5. When must a business pay federal unemployment taxes?

6. On what are state unemployment taxes usually based?

7. What does worker's compensation cover?

8. When are bonds usually required?

9. What does a contract bond guarantee?

10. What does a performance bond guarantee?

11. What does a stop notice type of lien accomplish?

12. What should a building contract contain?

13. Name the two usual types of building contracts.

14. How can progress payments from the owner help the contractor?

15. What are the advantages to the contractor of having sufficient cash on hand?

16. What device is used to relay information to the contractor, office, or workers at the job site?

17. What does an understaffed operation cause?

STUDENT INFORMATION SHEET

CARPENTRY

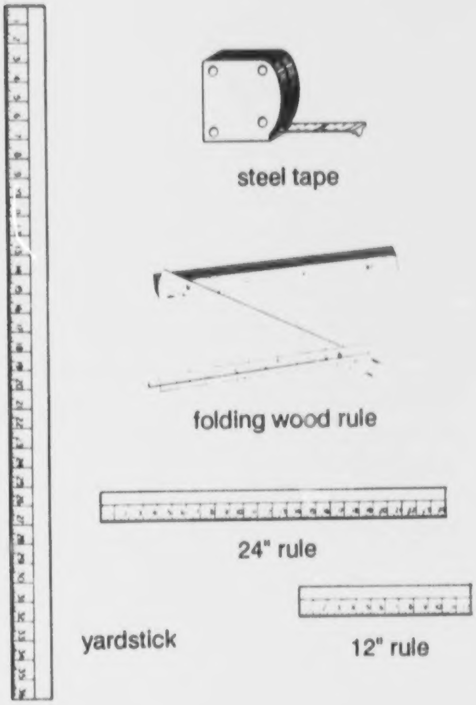
UNIT:	Introduction to Carpentry
TOPIC:	Tools and Equipment
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to identify tools used in carpentry.

The carpenter uses a very wide variety of tools in the carpentry trade. In fact, you could very likely take a complete course which would deal specifically with carpentry tools and how they are used. In this section you will be introduced to a number of the most common tools.

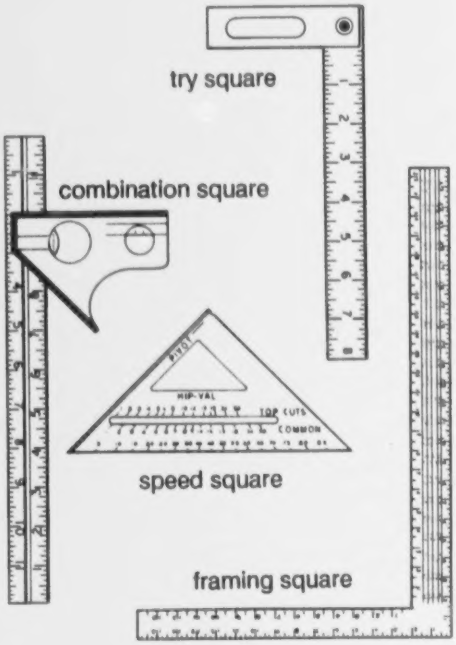
MEASURING AND LAYOUT TOOLS

Measuring tools are devices that are used to determine linear or angular measurement. Linear measurement is the measurement of distance on a straight line between two points. Angular measurement is the measurement of angles, trueness of surfaces, and relationships between surfaces. Some of the tools that may be used are shown below.

TYPES OF RULES



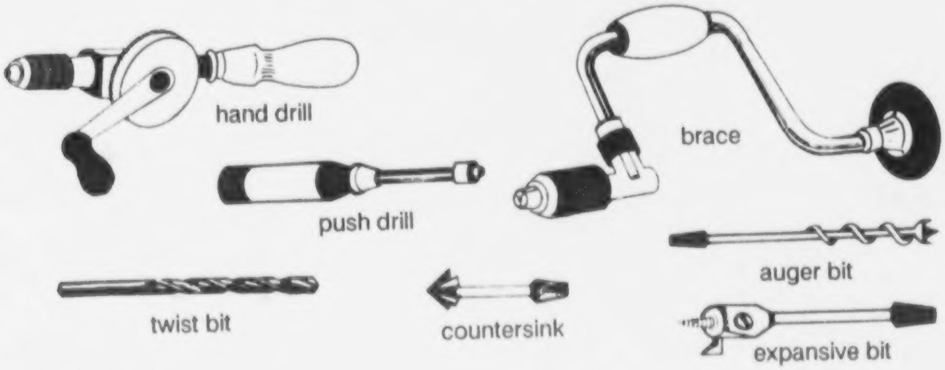
TYPES OF SQUARES



DRILLING AND BORING TOOLS

To become competent with drilling and boring tools, the carpenter must know about drilling tools, bitbraces, and various types of drill bits.

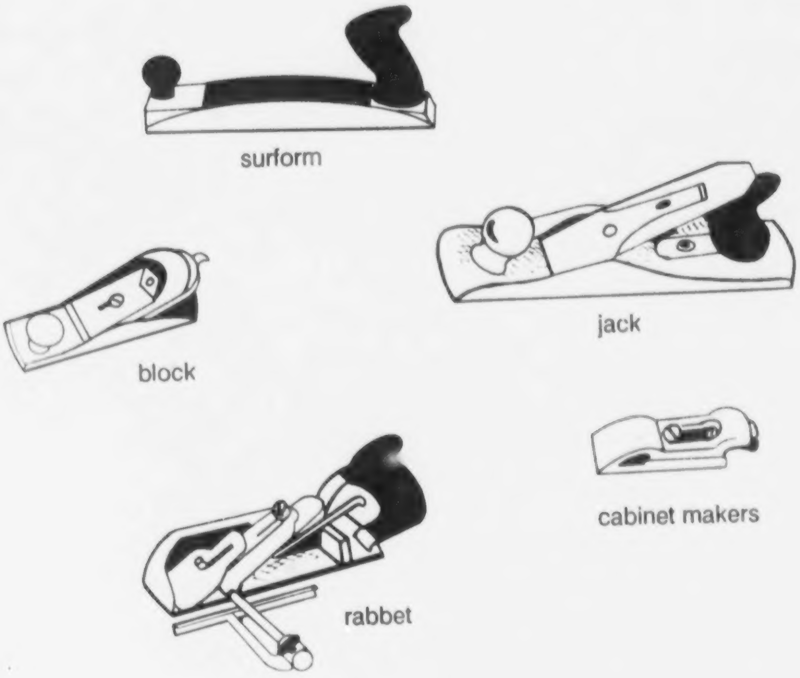
TYPES OF DRILLING AND BORING TOOLS


hand drill
brace
push drill
auger bit
twist bit
countersink
expansive bit

HAND PLANES

The hand plane is a tool with a blade or iron that is used for smoothing wood by removing wood shavings. It is nothing more than a special chisel that has been placed in a block of metal at an angle. There are many different types of hand planes and a variety of uses for each.

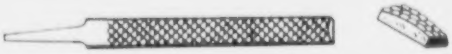
TYPES OF PLANES

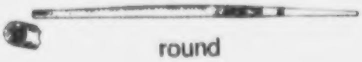

surform
jack
block
cabinet makers
rabbet

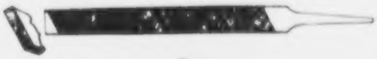
SCRAPING TOOLS

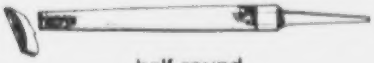
Scraping tools include files and rasps.

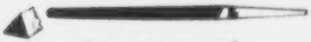
TYPES OF FILES


wood rasp


round


flat

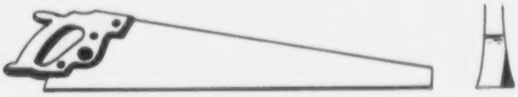

half-round

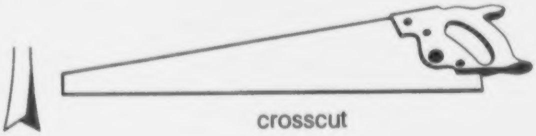

three-cornered

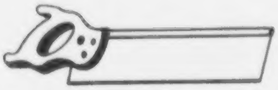
HANDSAWS

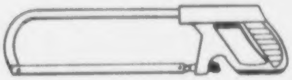
Whether a woodworker is a carpenter, cabinetmaker, or hobbyist, one of the first steps necessary in any project is cutting the material to size. This separation requires some type of saw. There are many types available, and each is designed for a special purpose. Know your saws, and you will not have to guess which saw to use to get the best results.

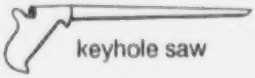
TYPES OF SAWS


rip saw


crosscut


back saw

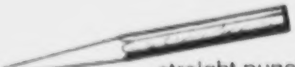

hacksaw


keyhole saw

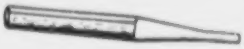
POUNDING AND DRIVING TOOLS

Pounding and driving tools include hammers, hatchets, roofing hammers, mechanical staplers, screwdrivers, and ripping bars. Each tool is designed for a specific job. You should know how to use and care for each one.

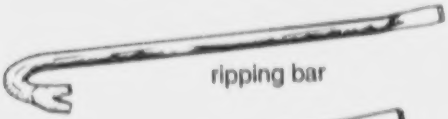
TYPES OF PRYING AND PUNCHING TOOLS



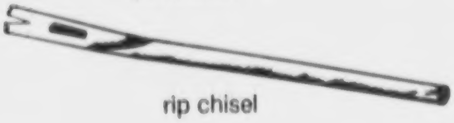
straight punch



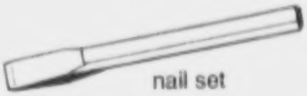
pin punch



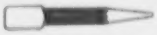
ripping bar



rip chisel

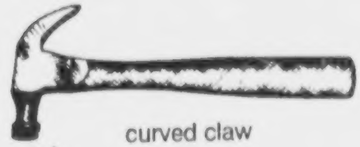


nail set

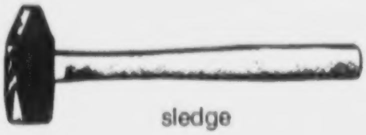


cold chisel

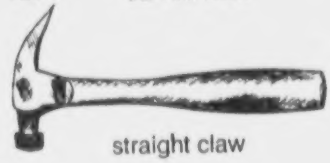
TYPES OF HAMMERS



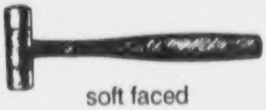
curved claw



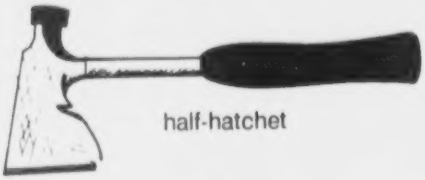
sledge



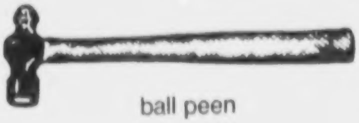
straight claw



soft faced

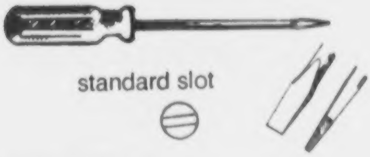


half-hatchet

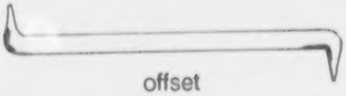


ball peen

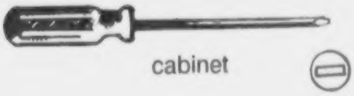
TYPES OF SCREWDRIVERS



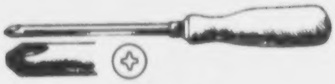
standard slot



offset



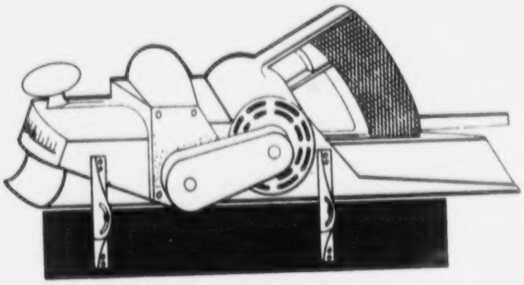
cabinet



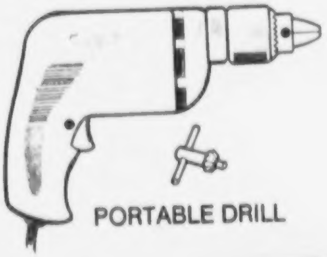
phillips

PORTABLE POWER TOOLS

Power tools come in almost as wide a variety as hand tools. It is very important when learning to use power tools that you follow the manufacturer's recommendations for use and safety precautions. Below are examples of portable power tools the carpenter uses.



POWER PLANE



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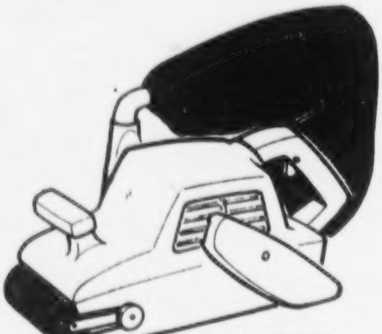
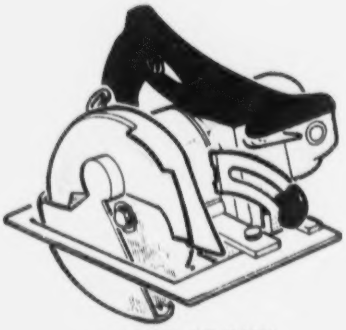
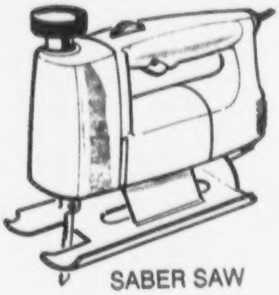


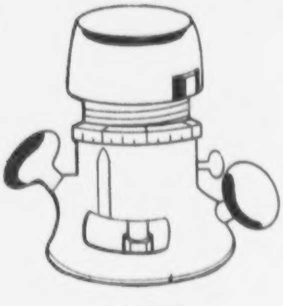
BELT SANDER



CIRCULAR SAW



SABER SAW



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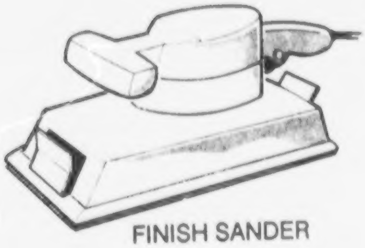


FINISH SANDER

ASSIGNMENT SHEET

CARPENTRY

NAME:_______________________________________**DATE:**____________

UNIT: Introduction to Carpentry

TOPIC: Tools and Equipment

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

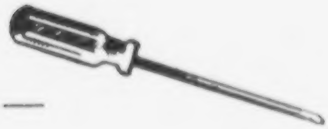
SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify tools used in the carpentry trade.

REFERENCE: Student Information Sheet/Tools and Equipment

DIRECTIONS: Identify each of the following carpentry tools by placing the correct letter in the blank.

A. Brace
B. Steel tape
C. Jack plane
D. Flat file
E. Rip saw
F. Curved claw hammer
G. Hand drill
H. Saber saw
I. Standard slot screwdriver
J. Circular saw
K. Ripping bar
L. Combination square
M. Keyhole saw
N. Portable drill
O. Wood rasp

1. ___



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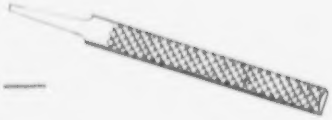

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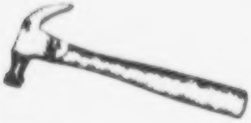

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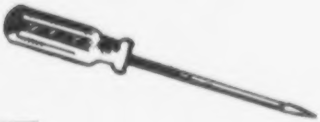

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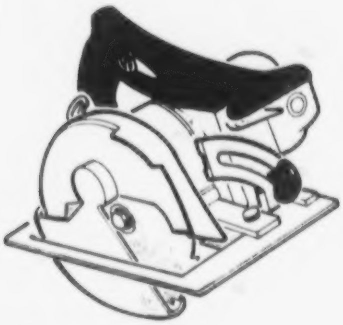

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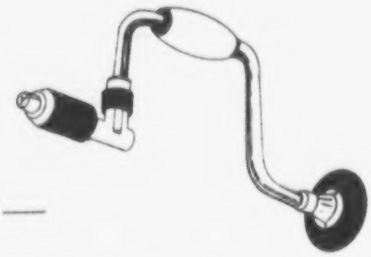

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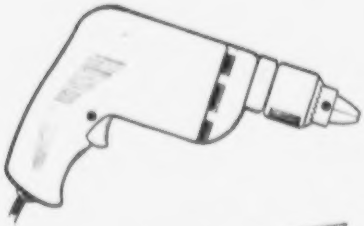

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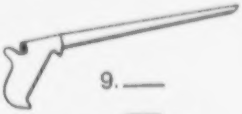

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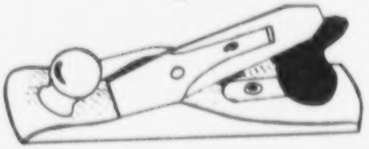

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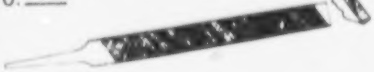

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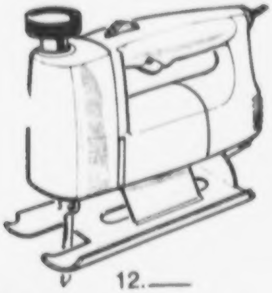

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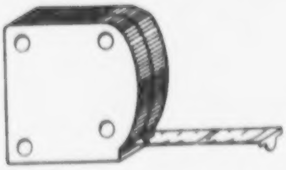

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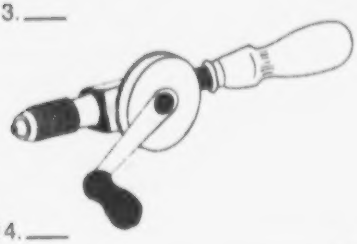

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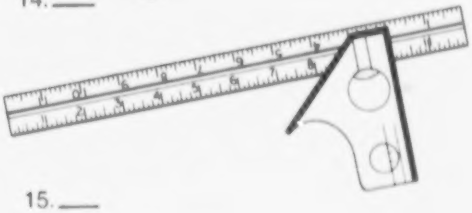


15. ___

JOB SHEET

CARPENTRY

NAME:________________________________ **DATE:**________________________

UNIT: Introduction to Carpentry

NAME OF JOB: Using Carpentry Hand Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to use a carpentry hand tool.

TOOLS AND EQUIPMENT: Display of carpentry hand tools

MATERIALS: No materials are required.

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Select one tool from the display.
2. Using proper safety precautions, demonstrate how the tool should be used.
3. Replace the tool.

JOB SHEET

CARPENTRY

NAME:______________________________ **DATE:**______________________

UNIT: Introduction to Carpentry

NAME OF JOB: Using Carpentry Power Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to use a carpentry power tool.

TOOLS AND EQUIPMENT: Display of carpentry power tools

MATERIALS: No materials are required.

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Select one tool from the display.
2. Using proper safety precautions, demonstrate how the tool should be used.
3. Replace the tool.

STUDENT INFORMATION SHEET

CARPENTRY

UNIT:	Introduction to Carpentry
TOPIC:	Building Materials
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to identify materials used in the carpentry trade.

The quality and ease of your carpentry are both affected by the materials you select. Wood that is not resistant to decay will rot. Wood that is too weak for construction may collapse under stress. Wood that splinters easily is hard to work with. Some wood resists paint, while others weather well without it.

Wood has been divided into two groupings, hardwoods and softwoods. Hardwoods include oak, birch, and maple. Cabinets and other finish work are usually made from hardwoods. Softwoods include fir, cedar, and pine. These woods are used for framing, fencing, and sometimes trim. Lumber is sized in two ways, normal size (2" x 4") and actual size (1 1/2" x 3 1/2").

Plywood is a form of wood used a great deal in carpentry. It is made of crossbanded layers of veneer and/or lumber bonded together with glue. There are several grades of plywood available. The grade of plywood you select for use will depend on the job you are doing. Plywood is produced in 4 feet by 8 feet (4'x8') sheets. The sheets of plywood range in thickness from 1/4 inch to 3/4 inch.

Particle board is another commonly used form of wood in building. It is made of planer shavings, wood chips, and logs bonded together with glue. Like plywood, particle board is produced in (4' x 8') sheets and comes in thicknesses ranging from 1/4 inch to 1 inch.

There are many other types of materials you will come in contact with when working in carpentry. As stated earlier, the quality of the job you perform will depend a great deal on your knowledge of materials available and how they are used.

ASSIGNMENT SHEET

CARPENTRY

NAME:____________________________________**DATE:**____________

UNIT: Introduction to Carpentry

TOPIC: Building Materials

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify materials used in the carpentry trade.

REFERENCE: Student Information Sheet/Building Materials

DIRECTIONS: Select nine samples of wood from the display provided by your instructor. Write a brief description of the wood. Include such items as where the wood comes from, how it is produced, its thickness, and what it is used for. Refer to additional reference materials in your classroom for more information about building materials and how they are used.

STUDENT INFORMATION SHEET

CARPENTRY

UNIT: Introduction to Carpentry

TOPIC: Carpentry Terminology

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to demonstrate an understanding of the terminology used in carpentry.

When working in any occupation, you will find a specific terminology. The area of carpentry is no different. As your understanding of the terms used in the carpentry trade increases so will your ability to follow directions and perform your job. Following is a glossary of terms and definitions you will encounter in the area of carpentry. Study these terms carefully and keep the glossary as an important part of your reference information.

GLOSSARY

Air-dried lumber--lumber that has been piled in yards or sheds for any length of time; it is not artificially dried.

Anchor bolts--bolts used to fasten a wooden sill plate to concrete or masonry floor or wall.

Apron--the flat member of the inside trim of a window placed against the wall immediately beneath the stool.

Areaway--an open space below ground next to a building that is used to admit light or air or as a means of entering a basement.

Astragal--a molding attached to one of a pair of swinging doors, against which the other door strikes.

Backband--a simple molding sometimes used as a decorative feature around that outer edge of plain rectangular casing.

Backfill--putting back dirt into a trench around and against a basement foundation.

Balusters--usually small, vertical members in a railing used between a top rail and the stair treads or bottom rail.

Base or baseboard--a board placed around a room against the wall and next to the floor to finish properly between floor and plaster, gypsum board, or paneling.

Base molding--molding used to trim the upper edge of an interior baseboard.

Base shoe--molding used next to the floor on interior baseboard; sometimes called a carpet strip.

Batten--narrow strips of wood used to cover joints or as decorative vertical members over plywood or wide boards.

Batter board--one of a pair of horizontal boards nailed to posts set at the corners of an excavation; it is used to indicate the desired level and also as a fastening for stretched strings that show the outlines of foundation walls.

Batt insulation--insulation made from fiberglass, wood fiber, or mineral wool; it comes in packages, 24 to 48 inches long.

Bay window--any window space projecting outward from the walls of a building, either square or with sides at other angles.

Beam--a structural member that supports a load between walls.

Bearing partition--a partition that supports any vertical load in addition to its own weight.

Bearing wall--a wall that supports any vertical load in addition to its own weight.

Bed molding--a molding in an angle, as between the overhanging cornice or eaves of a building and the sidewalls.

Bevel--a cut made at an angle through the thickness of wood.

Blanket insulation--insulation made from fiberglass, wood fiber, or mineral wool; packaged in long rolls.

Blind stop--a rectangular molding, usually 3/4 by 1 3/8 inches or more in width, used in the assembly of a window frame; serves as a stop for storm and screen or combination windows and resists air leaking in.

Block bridging--blocks or short pieces of wood that are nailed between studs or joists.

Blue stain--a bluish or grayish discoloration of the sapwood caused by the growth of moldlike fungi on the surface and inside the wood.

Board measure--a method of measuring lumber; one board foot is represented by stock 1 inch thick, 12 inches wide, and 12 inches long.

Brace--an inclined (sloping) piece of framing lumber applied to a wall or floor to stiffen the structure. It is also a tool used to hold auger bits.

Brick veneer--a facing of brick laid against and fastened to the sheathing of a frame wall or tile wall construction.

Builder's level--an instrument that contains a telescope; used to lay out buildings and building sites and to level walls, foundations, floors, and machinery bases.

Butt joint--the place where the ends of two pieces of stock meet in a square-cut joint.

Cant strip--a triangular-shaped piece of lumber used where a flat deck and a wall meet to prevent cracking of the roofing that is applied over it.

Casing--molding of various widths and thicknesses used to trim door and window openings at the jambs.

Chamfer--a beveled edge or cut that does not project through the entire thickness of the piece of stock.

Chord (bottom)--a member that runs horizontally along the bottom of a truss between walls.

Chord (top)--a truss member that runs diagonally from the heel to the peak of the roof.

Close-grained lumber--lumber with small, closely spaced pores.

Coarse- or open-grained lumber--lumber with open or large pores.

Construction, drywall--a type of construction in which the interior wall finish is applied in a dry condition, generally in the form of sheet materials or wood paneling, as contrasted with plaster.

Construction, frame--a type of construction in which the structural parts are wood or depend upon a wood frame for support.

Construction takeoff--a detailed chart or listing of all materials and fixtures needed to do a particular job.

Contour lines--lines on a plot plan that show points of equal elevation on the ground.

Corner boards --used as trim for the external corners of a house or other frame structure against which the ends of the siding are finished.

Cornice--overhang of a pitched roof at the eave line, usually having a fascia board, a soffit for a closed cornice, and the proper moldings.

Cove molding--a molding with a concave face used as trim or to finish interior corners.

Crossbridging--diagonal bracing between floor joists, placed near the center of the joist span to prevent joists from twisting.

Dado--a rectangular groove across the width of a board or plank; in interior decoration, a special type of wall treatment.

Decay--disintegration (coming apart) of wood or other substance through the action of fungi.

Decibel--the measurement of the intensity of sound.

Doorjamb, **interior**--the surrounding case into which and out of which a door opens and closes; it consists of two upright pieces, called side jambs, and a horizontal head jamb.

Dormer--an opening in a sloping roof whose framing projects out to form a vertical wall suitable for windows or other openings.

Downspout--a pipe, usually metal, for carrying rainwater from roof gutters.

Dressed and matched (tongued and grooved)--boards machined in such a way that there is a groove on one edge and a matching tongue on the other.

Drip cap--a molding placed on the exterior top side of a door or window frame; it causes water to drip beyond the outside of the frame.

Drywall--interior covering material, such as gypsum board or plywood, that is applied in large sheets or panels.

Eaves--the margins or lower parts of a roof projecting over the wall.

Fascia, or **facia**--a flat board, band, or face, used sometimes by itself, but usually with moldings and often located at the outer face of the cornice.

Fire stop--a solid, tight blocking of a concealed space, placed to prevent the spread of fire and smoke through the space.

Flashing--sheet metal or other material used in roof and wall construction to protect a building from water seepage.

Footing--a masonry section, usually concrete, in a rectangular form, wider than the bottom of the foundation wall or pier it supports.

Foundation--the supporting part of a structure below the first-floor construction or below ground level; includes footings.

Framing, balloon--a system of framing a building in which all vertical structural elements (like studs) of the bearing walls and partitions consist of single pieces extending from the top of the foundation sill plate to the roof plate; all floor joists are fastened to these members.

Framing, platform--a system of framing a building in which the floor joists of each story rest on the top plates of the story below (or on the foundation sill for the first story); the bearing walls and partitions rest on the subfloor of each story.

Frieze--in house construction, a horizontal member connecting the top of the siding with the soffit of the cornice.

Fungi, wood--microscopic plants that live in damp wood and cause mold, stain, and decay.

Furring--strips of wood or metal applied to a wall or other surface to even it and normally to serve as a fastening base for finish material.

Gable--the portion of the roof above the eave line of a double-sloped roof.

Girder--a large or principal (main) beam of wood or steel used to support concentrated loads at certain points along its length.

Grade--steepness of a slope; sometimes it means ground surface level.

Grade elevation--the elevation of a surface at a particular point.

Grain--the direction, size, arrangement, appearance, or quality of the fibers in wood.

Gussets--usually metal plates that fasten truss members together at the point of intersection.

Gypsum board (Sheetrock)--sheet material made of a gypsum filler faced with paper and used on walls and ceilings.

Hardwood--wood fibers pressed under heat and pressure to form sheets.

Header--a beam used perpendicular to joists and to which joists are nailed in framing for chimneys, stairways, or other openings.

Heartwood--the wood, extending from the pith to the sapwood, whose cells no longer take part in the life processes of the tree.

Hip roof--a roof that rises by inclined planes (slopes) from all four sides of a building.

Insulation board, rigid--a structural building board made of coarse wood or cane fiber in thicknesses of 1/2 and 25/32 inch; it can be obtained in various sizes of sheets, densities, and treatments.

Insulation, thermal--any material, highly resistant to heat transmission (movement); when placed in the walls, ceiling, or floors of a structure, it will reduce the rate of heat flow.

Jack rafter--a rafter that spans the distance from the wall plate to a hip or from a valley to a ridge.

Jamb--the side and head lining of a doorway, window, or other opening.

Joist--one of a series of parallel beams, usually 2 inches thick, used to support floor and ceiling loads; it is supported, in turn, by larger beams, girders, or bearing walls.

Kiln-dried lumber--lumber that has been dried in a large oven or room; often has a moisture content of from 6 to 12 percent.

Knot--the portion of a branch or limb of a tree that appears on the edge or face of a piece of wood.

K value--the amount of heat, in British thermal units (BTU), that passes through 1 square foot of material that is 1 inch thick per 1° Fahrenheit temperature difference between the inner and outer faces of the material.

Landing--a platform between flights of stairs or at the end of a flight of stairs.

Lath--a building material of wood, metal, gypsum, or insulating board that is fastened to the frame of a building to act as a plaster base.

Louver--an opening with a series of horizontal slats so arranged as to permit ventilation, but to keep out rain and sunlight and provide privacy.

Mechanic's lien--a paper signed by both homeowner and builder so neither can assume ownership of both house and land until the terms of agreement have been met.

Miter joint--the joint of two pieces at an angle that bisects (cuts in half) the joining angle; for example, the miter joint at the side and head casing of a door opening is made at 45 degrees.

Molding--a wood strip having a curved or projecting surface used for decorative purposes.

Mortar--a paste made from various mixtures of lime, sand, cement, and water that hardens when dried; used between stone, brick or cement blocks.

Mortise--a slot cut into a board, plank, or timber, usually edgewise, that receives the tenon of another board or plank to form a joint.

Mullion--a vertical bar or divider in the frame between windows, doors, or other openings.

Newel--a post to which the end of a stair railing or balustrade is fastened.

Nonbearing wall--a wall supporting no load other than its own weight.

Nosing--the projecting angle of a molding or drip; usually applied to the projecting molding on the edge of a stair tread.

O.C. (on center)--the measurement of spacing for studs, rafters, or joists in a building from the center of one member to the center of the next.

Overhang--the distance that the rafters extend over the edge of the plate.

Paper, building--a general term for papers, felts, and similar sheet materials used in buildings, without reference to their properties or uses.

Paper, sheathing--a building material, generally paper or felt, used in wall and roof construction as a protection against the passage of air and sometimes moisture.

Particle board--similar to hardboard, but made from larger wood particles and used in thicker sheets.

Parting stop or strip--a small wood piece used in the side and head jambs of double-hung windows to separate upper and lower sashes.

Pitch--the incline (slope) of a roof, or the ratio of the total rise to the total width of a house; for example, an 8-foot rise and a 24-foot width is a one-third pitch roof; roof slope is expressed in the inches of rise per foot of run.

Pitch pocket--an opening running parallel to the annual rings of growth that usually contains, or has contained, either solid or liquid pitch.

Pith--the small, soft core at the original center of a tree; the wood grows around it.

Plaster grounds--strips of wood used as guides when plastering at wall bases and around window and door openings.

Plate--*sill plate*: a horizontal member anchored to a masonry wall; *soleplate*: bottom horizontal member of a frame wall; *top plate*: top horizontal member of a frame wall supporting ceiling joists, rafters, or other members.

Plot plan--compass direction of boundary lines giving a complete description of the property with dimensions.

Plumb--exactly perpendicular; vertical.

Quarter round--a small molding that has the cross section of a quarter circle.

Rafter--one of a series of structural members of a roof designed to support roof loads; the rafters of a flat roof are sometimes called roof joists.

Rafter, hip--a rafter that forms the intersection of an external roof angle.

Rafter, valley--a rafter that forms the intersection of an internal roof angle; the valley rafter is normally made of double, 2-inch-thick members.

Rail--cross member of panel doors or of a sash.

Rake--trim member that runs parallel to the roof slope and forms the finish between the wall and a gable roof extension.

R factor--the resistance per inch of insulation.

Ribbon--normally a 1-by-4-inch board fastened into the studs horizontally to support the ceiling or second-floor joists.

Ridge--the horizontal line at the junction of the top edges of two sloping roof surfaces.

Ridgeboard--the board placed on edge at the ridge of the roof; the upper ends of the rafters are fastened into these.

Rise--in stairs, the height of a step or flight of stairs.

Riser--each of the vertical boards closing the spaces between the treads of stairways.

Roof sheathing--the boards or sheet material fastened to the roof rafters on which the shingles or other roof covering are laid.

Run--in stairs, the net width of a step or the horizontal distance covered by a flight of stairs.

Sapwood--the outer zone of wood, next to the bark; in the living tree, it contains some living cells, as well as dead and dying cells.

Sash--a single, light frame containing one or more panes of glass.

Sash balance--a device, usually operated by a spring, designed to counterbalance a double-hung window sash.

Schedules--tables that give information concerning types and sizes of doors and windows.

Screed--a small strip of wood, usually the thickness of the plaster coat, used as a guide for plastering.

Seasoning--removing moisture from green wood in order to improve its usefulness.

Shake--a thick, hand-split, usually edge-grained shingle, resawed to form two shakes.

Shingles--roof covering of asphalt, asbestos, wood, tile, slate, or other material cut to stock lengths, widths, and thicknesses.

Sill--the lowest member of the frame of a structure, resting on the foundation and supporting the floor joists or the uprights of the wall; the member forming the lower side of an opening, as a doorsill, windowsill, etc.

Sleeper--usually, a wood member sunk in the concrete floor; serves to support and to fasten the subfloor or flooring.

Soffit--usually, the underside of an overhanging cornice.

Solid bridging--a solid member placed between floor joists near the center of the span to prevent joists from twisting.

Sound isolation--the reduction of the intensity of sound.

Sound transmission class (STC)--the designation that refers to the passage of airborne sound.

Span--the distance between structural supports such as walls, columns, piers, beams, girders, and trusses.

Specification sheets--sheets found in a set of blueprints, supplementary to the drawings. They contain specific sizes and instructions.

Stile--an upright framing member in a panel door.

Storm sash or **storm window**--an extra window usually placed on the outside of an existing one as added protection against cold weather.

String, stinger--a timber or other support for cross members in floors or ceilings; in stairs, the support on which the stair treads rest.

Strip flooring--wood flooring that consists of narrow, matched strips.

Stud--one of a series of slender wood or metal vertical structural members placed as supporting elements in walls and partitions.

Subfloor--boards or plywood laid on joists over which a finish floor is to be laid.

Symbols--small drawings that represent materials or objects on the plan such as electrical fixtures, windows, etc.

Tail beam--a relatively short beam or joist supported by a wall on one end and by a header at the other.

Termite shield--a shield, usually of metal that does not corrode; placed in or on a foundation wall or other mass of masonry or around pipes to prevent passage of termites.

Terneplate--sheet iron or steel coated with an alloy of lead and tin.

Threshold--a strip of wood or metal with beveled edges used over the finish floor and the sill of exterior doors.

Ties--metal rods fastened to wall forms to keep them from spreading when concrete is poured.

Toenailing--driving a nail at a slant with the initial surface in order to let it go into a second member.

Tread--the horizontal board in a stairway used to step on.

Trimmer--a beam or joist to which a header is nailed in framing for a chimney, stairway, or other opening.

Truss--a frame or jointed structure designed to act as a beam or long span; each member is usually subjected to lengthwise stress only, either tension or compression.

Valley--the internal angle formed by the junction (meeting) of two sloping sides of a roof.

Vapor barrier--material used to stop movement of water vapor into walls and prevent condensation in them.

Wales or walers--reinforcing members fastened to the stud when a foundation wall is more than 4 feet high.

Wane--the presence of bark or the lack of wood from any cause on the edge or corner of a piece of wood.

Webs--bracelike truss members that connect the top and bottom chords together.

ASSIGNMENT SHEET

CARPENTRY

NAME:____**DATE:**____________

UNIT: Introduction to Carpentry

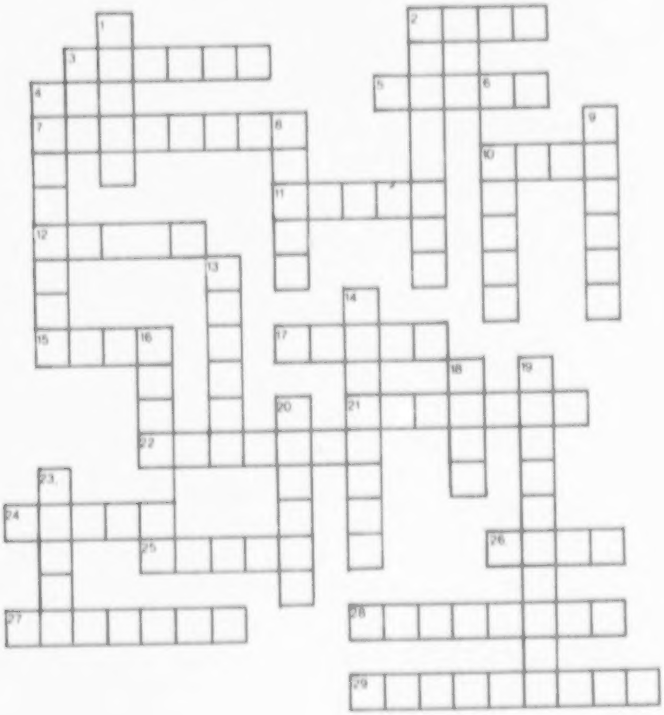
TOPIC: Carpentry Terminology

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with carpentry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of the terminology used in the carpentry trade.

REFERENCE: Student Information Sheet/Carpentry Terminology

DIRECTIONS: Using the glossary provided in Student Information Sheet/Carpentry Terminology as a reference, complete the crossword puzzle which follows. Become familiar with the terminology as you may be asked to discuss these terms in class.



ACROSS

2. The distance between structural supports such as walls, columns, piers, beams, girders, and trusses.

3. Molding of various widths and thicknesses used to trim door and window openings at the jamb.

5. The incline (slope) of a roof, or the ratio of the total rise to the total width of a house; for example, an 8-ft rise and a 24-ft width is a 1/3 pitch roof; roof slope expressed in the inches of rise per foot of run.

7. The distance that the rafters extend over the edge of the plate.

10. In stairs, the height of a step or flight of stairs.

11. A cut made at an angle through the thickness of wood.

12. One of a series of parallel beams, usually two inches thick, used to support floor and ceiling loads; it is supported, in turn, by larger beams, girders, or bearing walls.

15. A structural member that supports a load between walls.

17. Exactly perpendicular; vertical.

21. A masonry section, usually concrete, in a rectangular form, wider than the bottom of the foundation wall or pier it supports.

22. Interior covering material, such as gypsum board or plywood, that is applied in large sheets or panels.

24. The direction, size, arrangement appearance, or quality of the fibers in wood.

DOWN

1. The margins or lower parts of a roof projecting over the wall.

2. Roof covering of asphalt, asbestos, wood, tile, slate, and other material cut to stock lengths, widths and thicknesses.

4. The surrounding case into which and out of which a door opens and closes; it consists of two upright pieces, called side jambs, and a horizontal head jamb.

6. Overhang of a pitched roof at the eave line, usually having a fascia board, a soffit for a closed cornice, and the proper moldings.

8. The portion of the roof above the eave line of a double-sloped roof.

9. A beam used perpendicular to joists and to which joists are nailed in framing for chimneys, stairways, or other openings.

13. The internal angle formed by the junction (meeting) of two sloping sides of a roof.

14. Boards or plywood laid on joists over which a finish floor is to be laid.

16. A wood strip having a curved or projecting surface used for decorative purposes.

18. One of a series of slender wood or metal vertical structural members placed as supporting elements in walls and partitions.

25. Steepness of a slope; sometimes it means ground surface level.

26. The side and head lining of a doorway or other opening.

27. A wall that supports any vertical load in addition to its own weight.

28. Sheet metal or other material used in roof and wall construction to protect a building from water seepage.

29. Removing moisture from green wood in order to improve its usefulness.

19. Any material, highly resistant to heat transmission (movement); when placed in the walls, ceiling, or floor of a structure, it will reduce the rate of heat flow.

20. One of a series of structural members of a roof designed to support roof loads; the rafters of a flat roof are sometimes called roof joists.

23. An inclined (sloping) piece of framing lumber applied to a wall or floor to stiffen the structure. It is also a tool used to hold auger bits.

STUDENT INFORMATION SHEET

CARPENTRY

UNIT:	Fundamentals of Carpentry
TOPIC:	Introduction to Blueprints in Carpentry
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to demonstrate an understanding of the use of blueprints in carpentry.

Reading blueprints is not very complicated. However, you should take every opportunity to study any that are available. You should be able to recognize the symbols and abbreviations that indicate certain parts of the structure or materials needed.

Without blueprints, carpenters would be unable to build a structure that is precisely what the contractor, homeowner, or architect has in mind. Most disagreements between carpenters and other parties involved arise when drawings are incomplete or details are missing. The carpenter should carefully check the plans in detail before beginning any work on a structure.

When studying a blueprint, carpenters are first more interested in the overall structure. They ignore the details temporarily and give their attention to the length and width of the building. They then check to see whether a garage is attached or is separate, how many baths there are, and where partitions are located. They also check to see whether the structure is on ground level or is multi-story and whether it contains a fireplace.

After grasping the main features of construction, they turn their attention to details. They note specific types of windows and doors, types of fixtures, kitchen cabinet details, and details of other built-ins. Through further study, they learn about the wall construction, roof construction, and masonry requirements.

ASSIGNMENT SHEET

CARPENTRY

NAME:______________________________**DATE:**__________________

UNIT: Fundamentals of Carpentry

TOPIC: Introduction to Blueprints in Carpentry

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of the use of blueprints in carpentry.

REFERENCE: Student Information Sheet/Introduction to Blueprints in Carpentry

DIRECTIONS: After reading the following statements, indicate if the statement is true or false by circling the T or F.

T F 1. Reading blueprints is very complicated.

T F 2. When reading blueprints, you should be able to recognize the symbols and abbreviations that indicate certain parts of the structure or materials needed.

T F 3. Without blueprints, carpenters would be unable to build a structure that is precisely what the contractor, homeowner, or architect has in mind.

T F 4. Most disagreements between carpenters and other parties involved arise when drawings are incomplete or details are missing.

T F 5. Before beginning any work on a structure, the carpenter should carefully check the plans in detail.

T F 6. When studying a blueprint, carpenters are first more interested in the small details.

T F 7. When first studying a blueprint, carpenters ignore details temporarily and give their attention to the length and width of the building.

T F 8. Specific details include how many baths there are, where partitions are located, and whether there is a fireplace.

T F 9. Specific details include types of windows and doors, types of fixtures, and kitchen cabinet details.

T F 10. By studying blueprints, the carpenter can learn about construction, roof construction, and masonry requirements.

STUDENT INFORMATION SHEET

CARPENTRY

UNIT: Fundamentals of Carpentry

TOPIC: Floor Framing

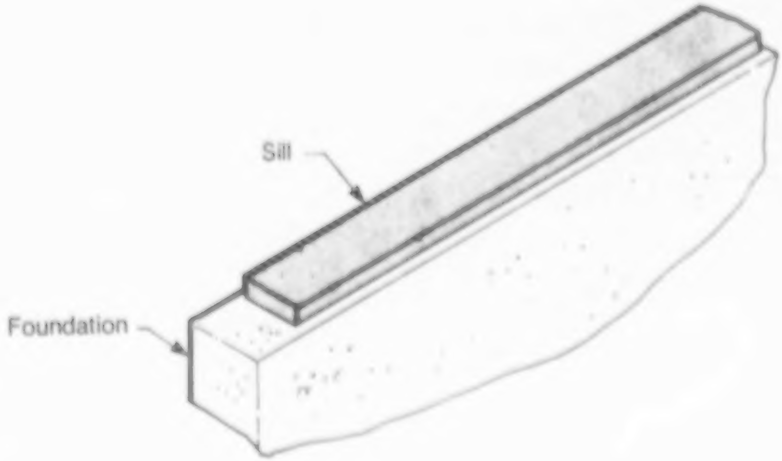
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to demonstrate an understanding of floor framing.

The stability of the entire house or building depends on the proper construction of sills, floor joists, and bridging. It is important that the wooden construction of the house be solid and true.

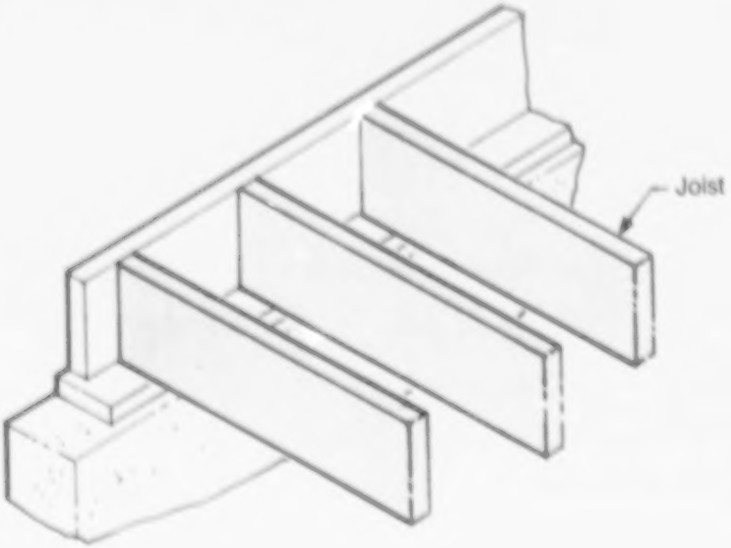
SILL

The floor frame starts with the sill. The sill may be one or two pieces of stock that rest on the foundation wall. The sill forms the support for the exterior of the building. Sills must be able to withstand decay, termites, and heavy compression loads. Sills should also have adequate nailing area.



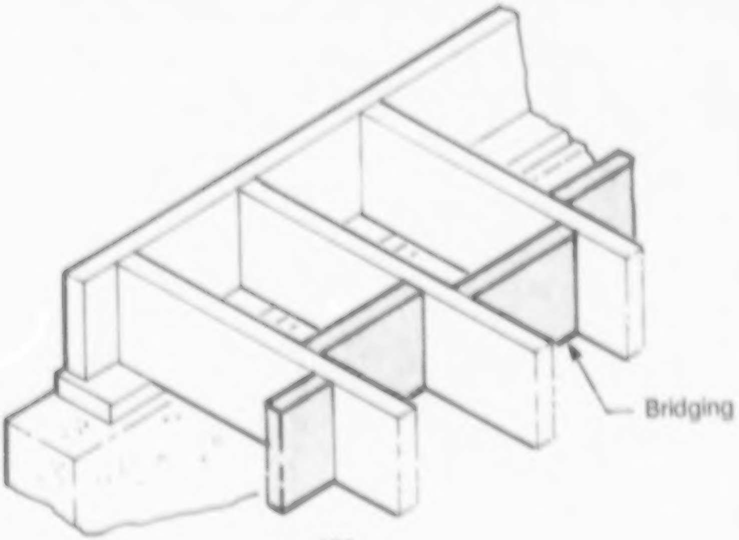
FLOOR JOISTS

Floor joists of inferior materials can easily cause construction failures throughout the structure. If the joists are not strong or if they are warped and crooked, the results may include sagging floors, sticking doors, and cracked walls. Floor joists rest upon the sills and carry the weight of the floor plus the live load of the furniture and people inside. The joists also act as ties between the interior partitions and the exterior walls.



BRIDGING

Bridging consists of braces that are placed between joists. They act as reinforcement and help distribute the weight of the floor over several joists so that it is not concentrated in one place. These braces should be fastened before the subfloor is laid.



ASSIGNMENT SHEET

CARPENTRY

NAME:______________________________ **DATE:**____________________

UNIT: Fundamentals of Carpentry

TOPIC: Floor Framing

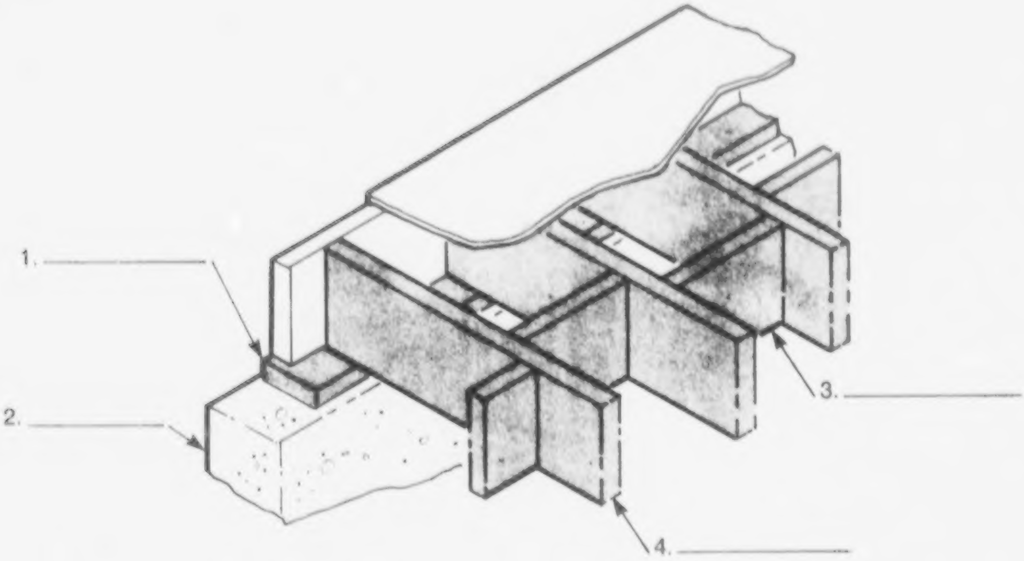
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of floor framing.

REFERENCE: Student Information Sheet/Floor Framing

DIRECTIONS: Using the words below, correctly label the floor frame drawing.

Joists	Foundation
Bridging	Sill



STUDENT INFORMATION SHEET

CARPENTRY

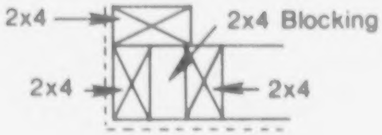
UNIT:	Fundamentals of Carpentry
TOPIC:	Wall Framing
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to demonstrate an understanding of wall framing.

Before you begin construction of a wall, you must first learn the parts which make up the wall frame. There are several terms you will encounter when you frame out a wall. Listed below are the parts of a wall with brief definitions.

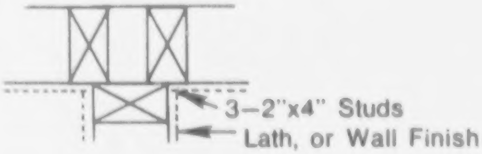
PARTS OF A WALL

1. **Stud**--a piece of dimension lumber (2"x4" or 2"x6") used to form the upright members of a wall frame.

2. **Corners**--the studs constructed to join two walls at a 90 degree angle, providing nailing surfaces on all sides.



3. **"T" or wall intersection**--Three studs constructed to join two walls at 90 degree angles on each side, providing a nailing surface on all sides.



4. **Trimmers**--the framing member on either side of a door or window opening on which the headers sit.

5. **Cripple**--dimension lumber used above and below the rough window openings to add strength to the wall and provide nailing surfaces.

6. **Header**--the framing member in a wall over a door or window.
   NOTE: It is usually a 2"x6" or 2"x12".

7. **Bottom plate**--the bottom portion of a wall running horizontally onto which studs are nailed and then secured to the floor.

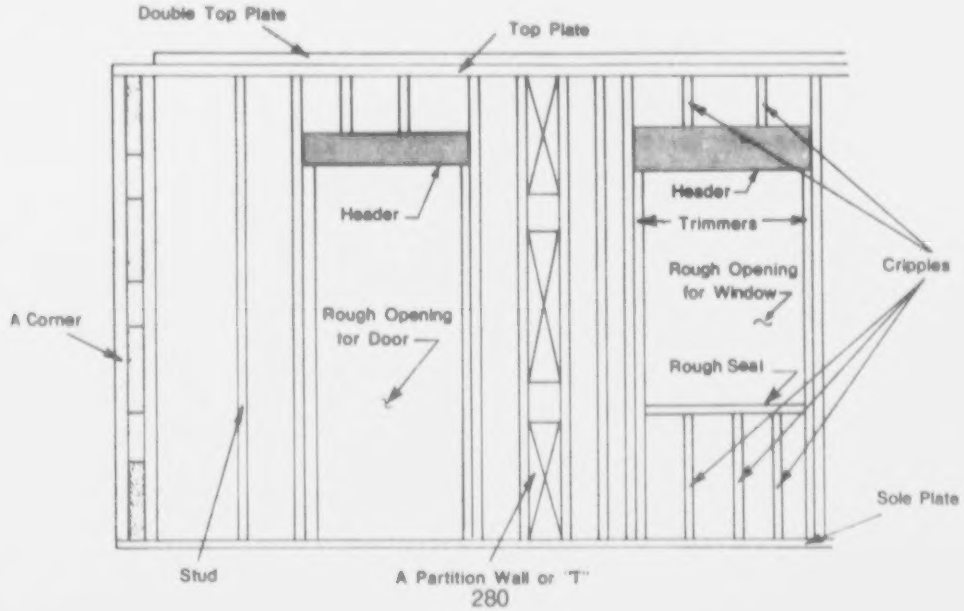
8. **Top plate**--the top piece of a wall to which the studs are nailed.

9. **Double plate**--an extra piece of lumber placed on the top of the plate to add strength and keep the wall straight.

10. **Door opening**--the opening in the wall where the door will be hung.

11. **Window openings**--the openings in the wall where windows will be installed.

12. **Rough seal**--the framing member in a wall under a window.


Double Top Plate
Top Plate
Header
Header
Trimmers
Cripples
A Corner
Rough Opening for Door
Rough Opening for Window
Rough Seal
Sole Plate
Stud
A Partition Wall or "T"

ASSIGNMENT SHEET

CARPENTRY

NAME:____**DATE:**________________________

UNIT: Fundamentals of Carpentry

TOPIC: Wall Framing

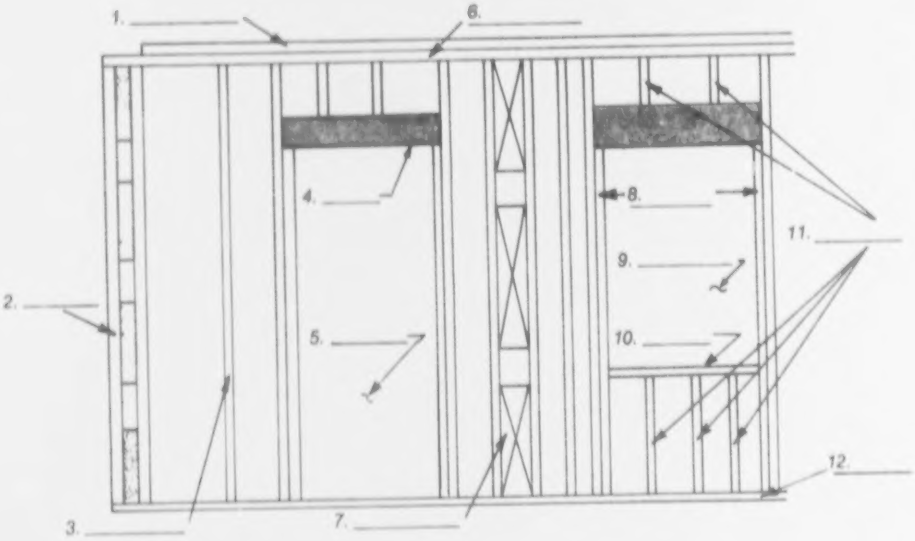
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate a knowledge of the parts of a wall frame.

REFERENCE: Student Information Sheet/Wall Framing

DIRECTIONS: Using the list provided, label the following picture of a wall frame.

A. Double top plate
B. Top plate
C. A corner
D. Stud
E. Header
F. Door opening
G. Cripples
H. Window opening
I. Rough seal
J. Sole plate
K. Trimmers
L. A partition wall or "T"

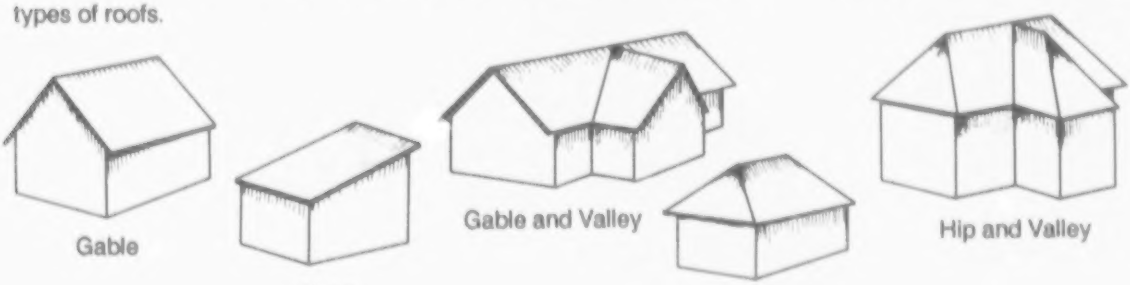


STUDENT INFORMATION SHEET

CARPENTRY

UNIT:	Fundamentals of Carpentry
TOPIC:	Roof Construction
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to demonstrate an understanding of roof construction.

Roof construction is a fundamental part of carpentry. As you gain experience working in carpentry, you will find that there are many different types of roofs. Following are examples of various types of roofs.



Gable

Shed

Gable and Valley

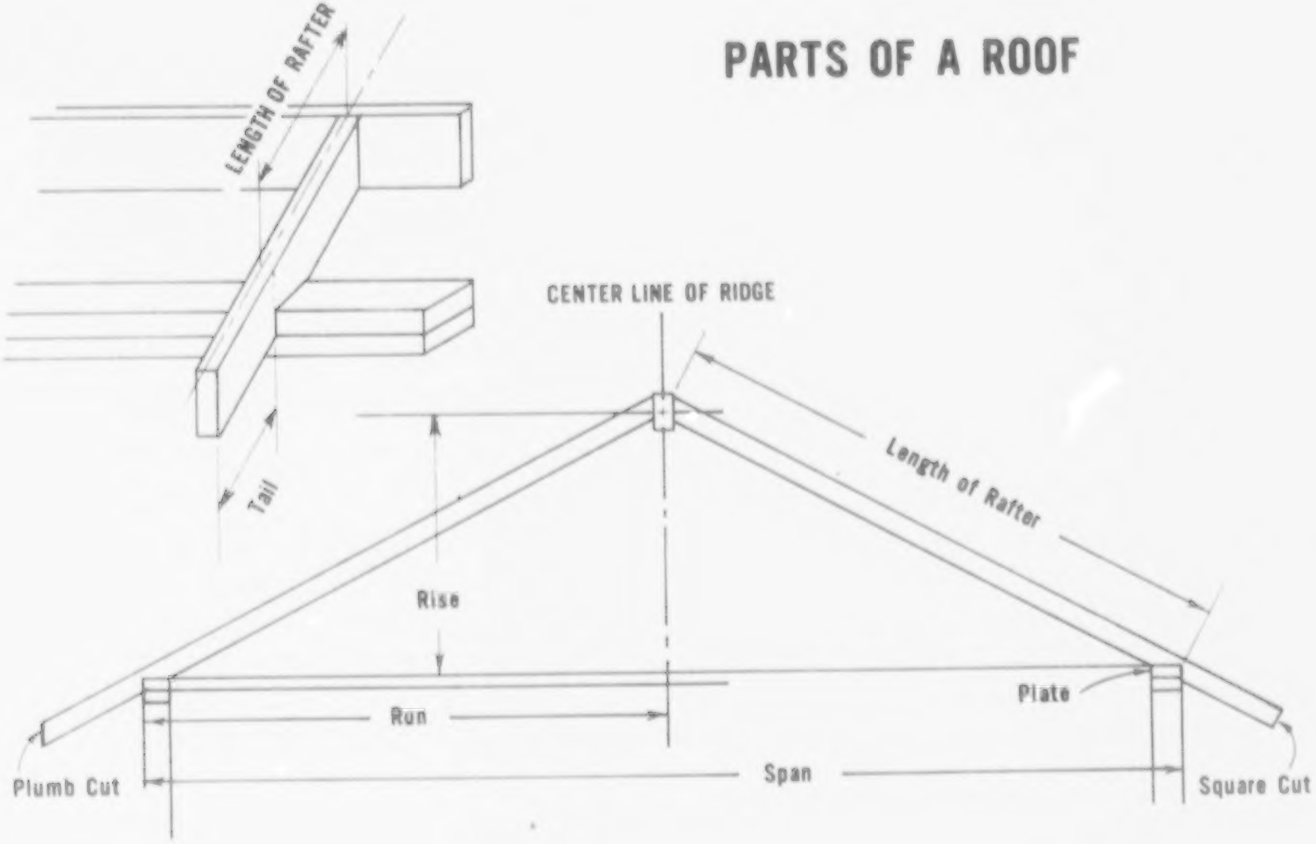
Hip

Hip and Valley

The same principles must be followed when constructing a roof as with any other part of the sructure. You must first learn the parts of the roof. Listed below are the parts of a roof along with brief definitions.

1. **Run**--distance from the outside of the top plate to the center of the roof.
2. **Span**--distance from outside of one top plate to the outside of the opposite top plate.
3. **Plate**--the part of the wall to which the roof is fastened.
4. **Length of rafter**--distance from the outside of the top plate to the ridge.
5. **Center line or ridge**--the middle line of the roof or ridge board.
6. **Rise**--the distance from the plate vertically to the center of the ridge.

PARTS OF A ROOF


LENGTH OF RAFTER
Tail
CENTER LINE OF RIDGE
Length of Rafter
Rise
Run
Plate
Plumb Cut
Span
Square Cut

7. Tail–the portion of the rafter from the wall to the end of the rafter which forms the overhang.

ASSIGNMENT SHEET

CARPENTRY

NAME:______________________________ **DATE:**__________________

UNIT: Fundamentals of Carpentry

TOPIC: Roof Construction

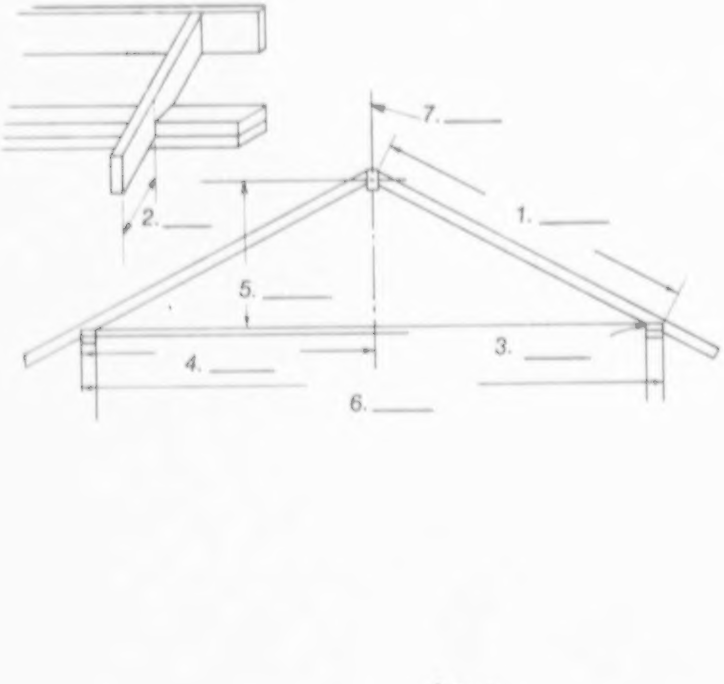
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of carpentry.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate a knowledge of the parts of a roof.

REFERENCE: Student Information Sheet/Roof Construction

DIRECTIONS: Using the list provided, label the following picture of a roof frame.

A. Run
B. Span
C. Plate
D. Length of rafter
E. Center line of ridge
F. Rise
G. Tail



JOB SHEET

CARPENTRY

NAME:____________________________________**DATE:**______________________

UNIT: Working In Carpentry

NAME OF JOB: Working With Hand and Power Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in carpentry.

SPECIFIC OBJECTIVE: Upon completion of this instructional unit, the student(s) will:

1. demonstrate the ability to square a board;
2. measure a board; and
3. cut a board using hand and power tools.

TOOLS AND EQUIPMENT: Hand saw (cross cut), circular saw, framing square, tape measure, pencil

MATERIALS: One Board (2"x4"x6')

GENERAL INSTRUCTIONS: Review safety precautions to use when working with hand and power tools. Make sure materials are secure before attempting to cut with either a hand or power saw. You will measure, square, and cut the 2"x4" board into the following lengths.

2 pieces 2"x4"x16"
2 pieces 2"x4"x19 1/4"

PROCEDURES AND/OR TASKS:

1. Using the square, make sure the end of the 2"x4" is square.

2. If the end of the 2"x4" is not square, use the pencil and square to mark the end of the 2"x4".

3. Use the hand saw to cut through your pencil mark. Check for squareness before you proceed.

4. Use the tape measure to measure the correct length. Mark the measurement with pencil. Use the square to make sure your pencil mark is correct.

5. Using the hand saw, cut through the pencil mark.

   CHECK POINT: Have your instructor check your work before proceeding.

6. Repeat steps one through five for each measurement given. Use the circular saw to cut the first two pieces of board.

   NOTE: Ask your instructor for assistance with the (power) circular saw.

CAUTION: Be sure to keep the saw cord and your fingers clear of the saw blade. Wear safety glasses.

7. Replace tools and materials.

8. Clean work area.

JOB SHEET

CARPENTRY

NAME:________________________________**DATE:**____________________

UNIT: Working in Carpentry

NAME OF JOB: Making a Form for a Concrete Slab

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in carpentry.

SPECIFIC OBJECTIVE: Upon completion of this instructional unit, the student(s) will have demonstrated the ability to build a form for a concrete slab.

TOOLS AND EQUIPMENT: Hammer, framing square, 24-nch level, 16 d duplex nails

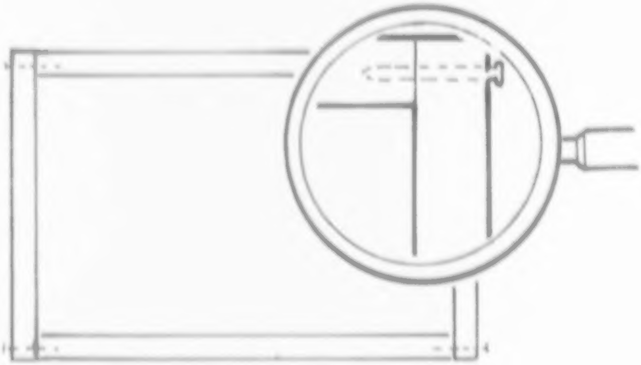
MATERIALS: 2 peices 2"x4"x16" board, 2 peices 2"x4"x19 1/4" board, 8 stakes

GENERAL INSTRUCTIONS: Level and clear the ground where the form is to be placed. Follow the steps below to build and set the form.

PRODECURES AND/OR TASKS:

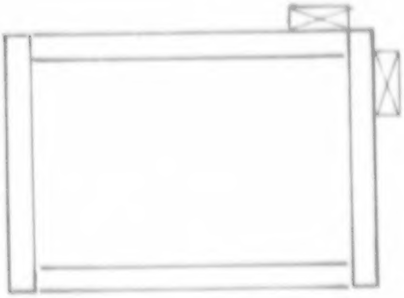
1. Nail the 4 pieces of 2"x4" together as shown below.

   NOTE: Drive duplex nails in snuggly to first head.



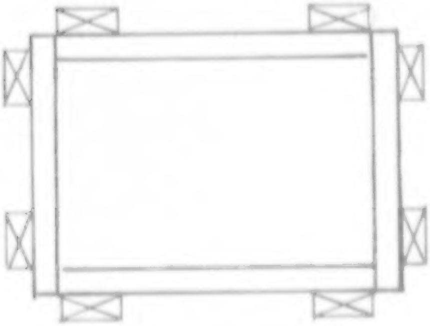
2. Use two nails at each corner.
3. Lay forms in position and check for squareness with square.

4. Drive two stakes in at each corner as shown.



5. Check outside corners for squareness.

6. Drive in the other six stakes.



CHECK POINT: Have your instructor check your work.

7. Replace tools and materials.

8. Clean work area.

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JOB SHEET

CARPENTRY

NAME:____________________________________**DATE:**______________________

UNIT: Working in Carpentry

NAME OF JOB: Constructing a Cabinetry Component

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in carpentry.

SPECIFIC OBJECTIVE: Upon completion of this instructional unit, the student(s) will have demonstrated the ability to construct a cabinetry component.

TOOLS AND EQUIPMENT: No. 2 1/2 or 3 common pencil, ruler, coping saw, two C-clamps, drill, and paintbrush

MATERIALS: one piece of 1/4" plywood 12" x 12", sandpaper, four to six cup hooks, varnish or paint, newspaper, cleaning solvent

GENERAL INSTRUCTIONS: Transfer pattern for the hot pad hanger, provided by instructor, onto the newspaper, or design your own pattern on the newspaper. (Make sure the pattern is no larger that 12" x 12".) Using the pencil trace the pattern onto the 1/4" plywood.

PRODECURES AND/OR TASKS:

1. Clamp the plywood to a sawhorse or other stable surface.
2. Use the coping saw to cut out the pattern.

   NOTE: Be careful not to cut into the sawhorse.
3. Use the sandpaper to sand the cut edges and surface smooth to the touch.
4. Use paintbrush to apply varnish or paint as desired.
5. Allow surface to dry overnight.
6. Clean paintbrush with cleaning solvent.
7. When surface is dry, screw cup hooks in place as shown on pattern, or as desired.
8. Replace tools and materials.
9. Clean work area.

SECTION IV

RESIDENTIAL ELECTRICIAN TRADE

RESIDENTIAL ELECTRICIAN TRADE

STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Safety

TOPIC: Electrical Safety Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to match the terms and definitions associated with electrical safety.

Below is a list of terms and definitions which you should become familiar with before starting to work in the residential electrician trade. Study these terms until you are comfortable in discussing what each one means.

1. **Accident**--any unplanned event which causes injury or damage
2. **Approved**--said to meet the required standards
3. **Dead circuit**--a disconnected circuit, usually caused by taking out a fuse, tripping a breaker, or unhooking service
4. **Defective**--not working correctly; faulty
5. **Electrical shock**--electric current passing through a person's body
6. **Ground**--a connection to the earth which serves as a return circuit and reduces danger
7. **Live wire**--current-carrying wire
8. **Modification**--a slight change in form or use
9. **Overload**--a circuit forced to carry more electric current than it is made to carry
10. **Qualified person**--a person who knows the work area involved
11. **Safety**--state of being free from danger, risk, or injury
12. **Short circuit**--a side current caused by bad wiring so that the electric current is turned aside from the main circuit

ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME: ______________________________ **DATE:** ______________

UNIT: Safety

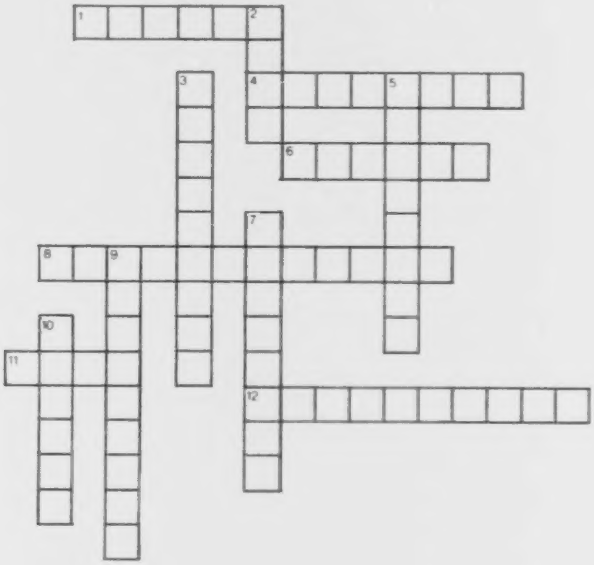
TOPIC: Electrical Safety Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will match the terms and definitions associated with electrical safety.

REFERENCE: Student Information Sheet/Electrical Safety Terms and Definitions

DIRECTIONS: Using the terms and definitions given on Student Information Sheet/Electrical Safety Terms and Definitions, complete the crossword puzzle below.



ACROSS

1. A connection to the earth which reduces danger

4. Meets the required standards established by authorities

6. State or condition of being safe; free from danger, risk or injury

8. A slight change in form or operation

11. A ___ wire is a current-carrying wire

12. ____ shock is the result of electrical current passing through a person's body

DOWN

2. A ___ circuit is a disconnected circuit, usually caused by removing a fuse, tripping a breaker, or disconnecting the service

3. A ___ person is one who is thoroughly familiar with the work area involved

5. A circuit or device forced to carry more electrical current than design allows

7. Any sudden, unplanned event which causes injury or property damage

9. Not in proper working order

10. A short ___ is an improper connection between hot wires or between hot and neutral wires

STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT:	Safety
TOPIC:	Electrical Accidents
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	After completion of this information sheet, the student will be able to discuss the causes and effects of electrical accidents.

Safety precautions are important in all areas of construction trades. However, working with electrical wiring requires additional caution.

COMMON CAUSES OF ACCIDENTS

There are several common causes of electrical accidents. Human failure, or the failure of individuals to use safe working practices, starts off this list. The failure to make necessary repairs on faulty (bad) equipment may also cause accidents. Individuals may become careless and fail to observe safety rules. Careless behavior of this nature results in accidents. Modification of equipment which results in by-passing safety features is dangerous. Misusing tools or equipment can cause accidents.

Other areas of danger which may result in electrical accidents include defective equipment or tools. You should check to see that the ground wire is functioning correctly. This means checking for missing, broken, misconnected, or disconnected ground wire. Insulation must also be checked. Wet or oily insulation is a good electrical conductor. Worn or cut insulation means there is a good chance of shock. Tools should be checked for broken guards, damaged power cords, improper switches or no switch. One final cause of accidents is ignorance or simply not knowing proper safety procedures.

EFFECTS OF ELECTRICAL ACCIDENTS

The effects of electrical accidents can range from minor to major. The accident may result in cuts or abrasions, falls or spills, burns, or shock. However, you should always remember that accidents, especially electrical accidents, may result in **death**.

One amp of electrical current for one second of contact can cause death. Safety is a matter of life or death when working with electricity. Other effects of electrical accidents include **crippling**--severe burns can cause loss of limb, sight, or ability to move; **loss of time**--accidents caused by electricity account for four percent of job time lost in the U.S.; **loss of material**--fire caused by electricity results in millions of dollars of material loss each year; **loss of job**--most employers will not keep a dangerous worker on the job.

ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:____________________________________ **DATE:**____________________

UNIT: Safety

TOPIC: Electrical Accidents

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will list the causes and effects of electrical accidents.

REFERENCE: Student Information Sheet/Electrical Accidents

DIRECTIONS: Answer each of the following as indicated.

1. List four common causes of electrical accidents. Give a brief example of each.

   a.

   b.

   c.

   d.

2. List three effects of electrical accidents and give an example of each.

   a.

   b.

   c.

JOB SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:______________________________ **DATE:**______________________

UNIT: Safety

NAME OF JOB: Safety Check

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to perform a safety check on power tools.

TOOLS AND EQUIPMENT: Display of power tools

MATERIALS: No materials are required.

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Select one power tool from the display.
2. Check for missing, broken, misconnected, or disconnected ground wire.
3. Make sure insulation is dry.
4. Check for broken guard.
5. Check for improper switch or no switch.
6. Replace the tool.

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STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT:	Introduction to Careers in the Residential Electrician Trade
TOPIC:	Occupational Outlook
UNIT OBJECTIVE:	After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in the electrical trades.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to discuss career opportunities available in the area of electrical trades.

Most residential electricians plan, install, and repair electrical circuits and components in existing buildings as well as those under construction.

Duties

When electricians are working on new structures, their duties include the installation of power panel boxes, conduit, outlet boxes, and other concealed or recessed equipment before the interior walls and ceilings are completed. Electricians must be able to read blueprints, rough sketches, and follow verbal instructions in order to install electrical cables along walls, ceilings, and floors. They must be able to mount outlet boxes for light fixtures, switches, outlets, heating and air conditioning units, and machinery/appliances. Also, they must secure panel boxes in position and make circuit connections. After the walls, ceilings, and floors are in place, the electrician installs lighting fixtures, switch and outlet covers, and other electrical components.

Electricians who work on existing buildings must first locate the source of the problem (troubleshoot), repair or replace defective cables and/or electrical units, and check their operation. The work may involve tracing existing circuits, replacing or running new circuits and outlets, and changing panel boxes.

The work which electricians do is subject to approval by building inspectors. This means they must follow state and local building ordinances and the National Electrical Code. Electricians work with drills, electrical testers, pipe benders, and other tools.

Working Conditions

Residential electricians work both indoors and out-of-doors. Those who work out-of-doors are exposed to varying weather conditions. A job may require working from beams, scaffolds, or ladders. The electrician may have to perform repairs in poorly lighted areas such as cramped crawl spaces or attics. Hazards for this trade include falls from ladders and electrical shock. Injuries can be kept at a minimum, however, by observing safety precautions.

Training Requirements

An electrician must have good color perception, manual dexterity, and mechanical/electrical aptitude. Dependability, average intelligence, ability to follow oral and written directions, and the ability to get along with others are important.

It is recommended that electricians have completed a formal four-year apprenticeship program. It is possible, however, to learn the trade through informal on-the-job training. Wages are based on training, skill, and experience. Geographical location may make a difference in the amount the electrician will earn. Wages range from $8.00 to $20.00 per hour.

Outlook

The employment outlook for electricians depends on construction activity and will vary depending on the rise or fall in the construction industry.

ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:________________________________ **DATE:**__________________

UNIT: Introduction to Careers in the Residential Electrician Trade

TOPIC: Occupational Outlook

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in the electrical trades.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will answer questions regarding careers in the area of electrical trades.

REFERENCE: Student Information Sheet/Occupational Outlook

DIRECTIONS: Read each of the following statements. If the statement is true, circle the T. If the statement is false, circle the F.

T F 1. Residential electricians work only on new buildings.

T F 2. Electricians who work in the area of repair must first locate the source of the problem.

T F 3. Electricians are often required to work in crawl spaces or attics.

T F 4. Remodeling work may involve tracing existing circuits and replacing or running new circuits and outlets.

T F 5. Electricians work independently and do not require any type of approval on their work.

T F 6. A four-year apprenticeship program is recommended for electricians.

T F 7. All electricians will earn the same wage regardless of their training, skill, or experience.

T F 8. Wages for electricians range from $8.00 to $20.00 per hour.

T F 9. Electricians may learn through informal on-the-job training.

T F 10. The employment outlook for electricians depends on the activity in the area of construction.

STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Introduction to the Residential Electrician Trade

TOPIC: Sources of Electrical Power

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to discuss the sources of electrical power.

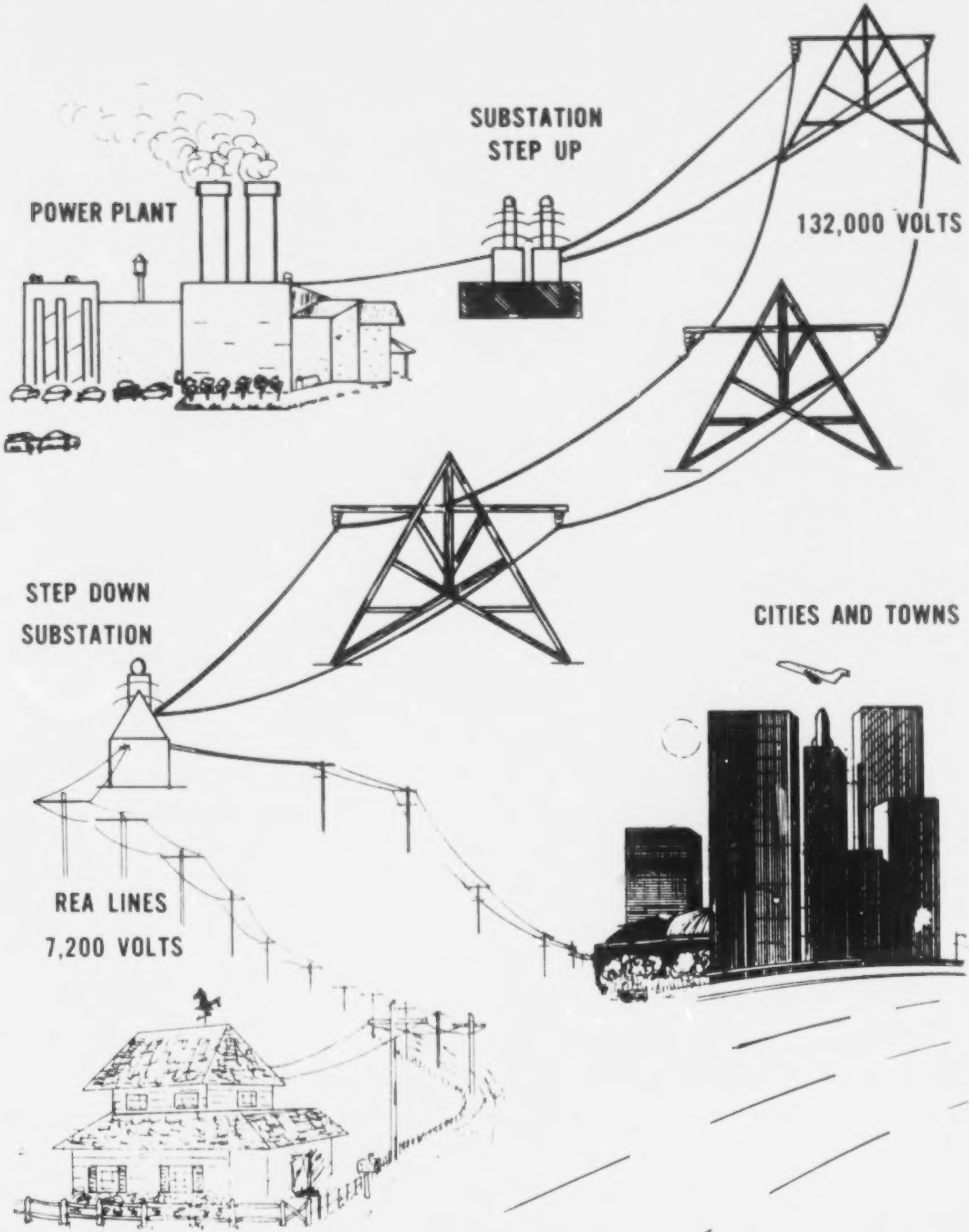
We use electrical power every day in every phase of our lives. It is taken for granted. When you walk into a room and flip a light switch, you expect the light to come on. If you turn the knob on the radio, you expect to hear music. These conveniences, which all of us are use to, rely on power provided by electricity. Where does electricity come from? How is it made available for consumer use?

Electricity is produced by power plants. There are four types of electric power plants operating today. These include hydro-electric plants, gas-fired electric plants, coal-fired electric plants, and atomic generating plants. Basically this means that electricity can be produced with a variety of fuels. In the future there may be new methods discovered which will make electricity available. Sometimes individuals choose to produce their own electricity. This is possible through the use of individually owned electrical generators. These generators may be wind-powered, gasoline-powered, or solar-powered. Excess electricity produced by these individually owned generators is purchased by local power companies and sold to other consumers. Power companies are simply companies which make electrical service available to consumers. There are different types of power companies operating. These may be publicly owned, privately owned, or cooperatives.

Electricity reaches the consumer through a series of steps. Power lines move the electricity from the power plants to the consumer. There are three types of power lines involved in the process of moving the electricity. **Transmission lines** are electrical lines that extend from generating plants to sub-stations or distribution centers. **Distribution lines** begin at the sub-station or distribution center and extend to the user. Distribution lines usually run under 20 miles. **Service lines** run from the meter to the point of use (for example, a house).

There are two types of electrical services used in residential dwellings. A 110-volt requires two service lines running to the house. A 220-volt requires three service lines running to the house.

POWER DISTRIBUTION


SUBSTATION
STEP UP
POWER PLANT
132,000 VOLTS
STEP DOWN
SUBSTATION
CITIES AND TOWNS
REA LINES
7,200 VOLTS
FARM AND RURAL HOMES

ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:____ **DATE:**_______________________

UNIT: Introduction to the Residential Electrician Trade

TOPIC: Sources of Electrical Power

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will list sources of electrical power.

REFERENCE: Student Information Sheet/Sources of Electrical Power

DIRECTIONS: Answer each of the following in the space provided.

1. List four types of electrical power plants.

   a.

   b.

   c.

   d.

2. List three types of individually owned electrical generators.

   a.

   b.

   c.

3. List three types of power companies.

   a.

   b.

   c.

RESIDENTIAL ELECTRICIAN TRADE

4. List the three types of power lines discussed and give a brief description of each.

a.

b.

c.

STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Introduction to the Residential Electrician Trade

TOPIC: Uses of Electrical Power

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

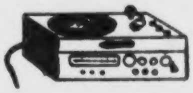
SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to discuss the uses of electrical power.

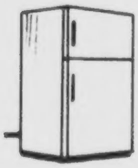
In the Student Information Sheet/Sources of Electrical Power, you learned where electricity comes from. Have you ever stopped to think about how and where all the electricity which is produced is used? You learned that there are two types of electrical services used in residential dwellings. Let's take a look at what these services are used for.

Electricity provides energy to light our homes, businesses, and industries. A high percentage of heating and cooling is powered by electricity. Power to operate appliances and machinery comes from electricity. Small appliances such as toasters, irons, televisions, etc. use a 110-volt electrical service. Larger appliances such as ranges, air conditioners, clothes driers, or large machines often require the use of a 220-volt electrical service.

Communication centers are powered by electricity. We give little thought to how radio and television waves are made available. Without electrical power it would be impossible to transmit these signals.

There are many other uses of electricity which could be discussed. Many of the necessities and conveniences available would not be possible without electricity.





ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME: ______________________________ **DATE:** ________________

UNIT: Introduction to the Residential Electrician Trade

TOPIC: Uses of Electrical Power

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will list uses of electrical power.

REFERENCE: Student Information Sheet/Uses of Electrical Power

DIRECTIONS: Answer each of the following in the space provided.

1. List the two types of electrical services used in residential dwellings and give three examples of what each one is used for.

   a.

      1)

      2)

      3)

   b.

      1)

      2)

      3)

2. List five ways in which you personally use electricity every day.

   a.

   b.

   c.

   d.

   e.

3. Write a paragraph about how your life would be different if electricity was no longer available.

STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Introduction to the Residential Electrician Trade

TOPIC: What Tools Are Used by Electricians?

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

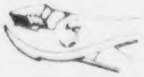
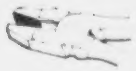
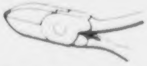
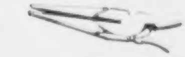
SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be familiar with the tools used by electricians.

If you choose to work in the residential electrician trade, there are many skills you will need to master. These skills require the use of a large variety of tools. Electricians are often required to furnish their own tools. In this class you will not have time to learn how to use all of the tools used by residential electricians. However, it is important that you become familiar with the type of tools required.

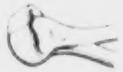
Following is a simple listing of electrical tools along with a drawing of the tool. By studying this information, you will be better informed about this trade. This information will assist you in making a decision about what trade you would like to work in.

RESIDENTIAL ELECTRICIAN TRADE

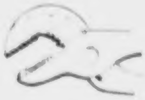
Tools Used in Electrical Wiring

I. Pliers
    A. Slip joint 
    B. Lineman 
    C. Diagonal cutter 
    (NOTE: Often called "dikes")
    D. Long nose 

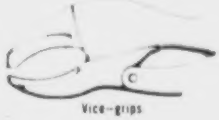
E. End cutter



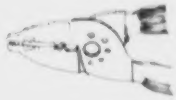
F. Channellock



G. Vice-grip

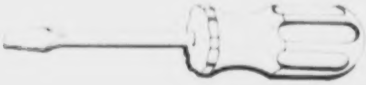


H. Wire stripper

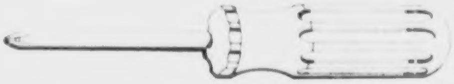


II. Screwdrivers

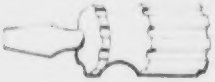
A. Straight slot



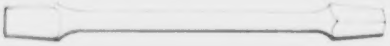
B. Phillips point



C. Stubby



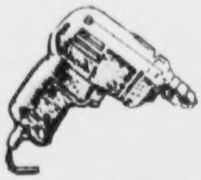
D. Screwdriver bit



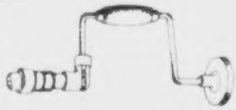
III. Drills and bits

A. Drills

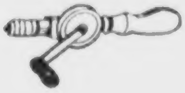
1. Power



2. Bit brace

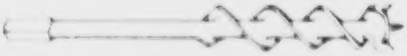


3. Hand drill

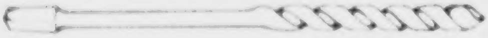


B. Bits

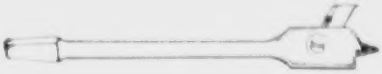
1. Auger



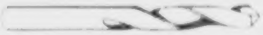
2. Wood twist



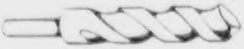
3. Expansive



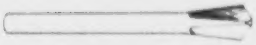
4. Twist drill



5. Masonry

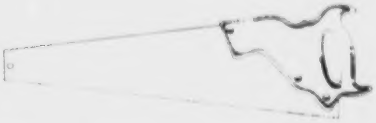


6. Star drill

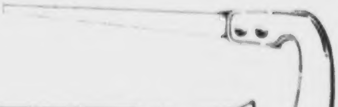


IV. Types of saws

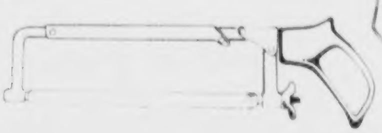
A. Crosscut hand



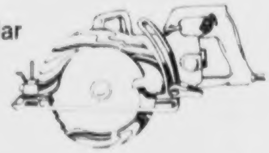
B. Keyhole



C. Hack

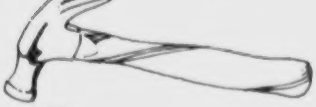


D. Power hand or circular

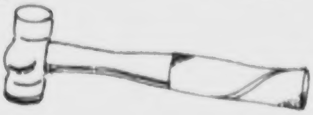


V. Hammers

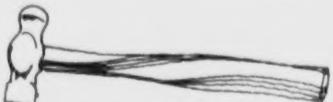
A. Claw



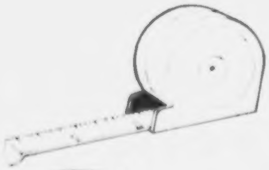
B. Lineman



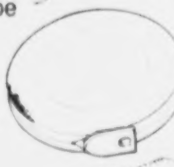
C. Ball peen



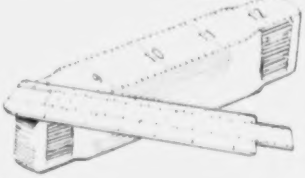
VI. Measuring devices



- A. 6- to 12-foot push-pull tape



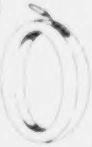
- B. 50- to 100-foot steel tape



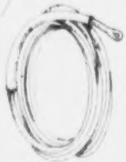
- C. Folding rule

VII. Special tools and equipment

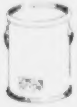
- A. Equipment for wire pulling
  1. Steel fish tape



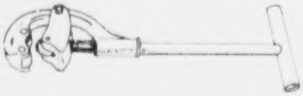
  2. Polyethylene fish tape



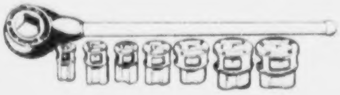
  3. Wire pulling lubricant



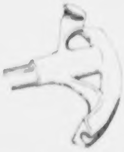
- B. Cutting and bending tools
  1. Pipe cutter



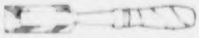
  2. Pipe threader



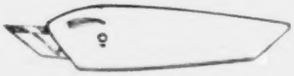
  3. Conduit bender



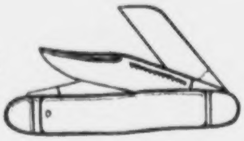
  4. Wood chisel



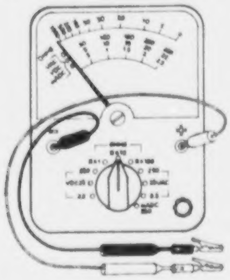
5. Utility knife



6. Pocket knife



7. Volt-ohm meter



ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:____________________________________ **DATE:**____________________

UNIT: Introduction to the Residential Electrician Trade

TOPIC: What Tools Are Used by Electricians?

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify tools used by electricians.

REFERENCE: Student Information Sheet/What Tools Are Used by Electricians?

DIRECTIONS: Your instructor will make a display of fifteen tools listed on Student Information Sheet/What Tools Are Used by Electricians? Each tool will be assigned a number only. On a sheet of paper, write the correct name of each tool beside the number of that tool.

JOB SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:______________________________ **DATE:**______________________

UNIT:	Introduction to the Residential Electrician Trade
NAME OF JOB:	Using Electrical Tools
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.
SPECIFIC OBJECTIVE(S):	In completing this job sheet, the student will demonstrate the ability to correctly use an electrical tool.
TOOLS AND EQUIPMENT:	Display of electrical tools
MATERIALS:	No materials are required.
GENERAL INSTRUCTIONS:	Follow instructions given in class.
PROCEDURES AND/OR TASKS:	1. Select one tool from the display. 2. Using proper safety procedures, demonstrate how the tool should be used. 3. Replace the tool.

RESIDENTIAL ELECTRICIAN TRADE

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STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

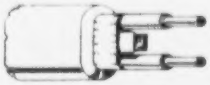
UNIT:	Introduction to the Residential Electrician Trade
TOPIC:	What Materials Are Used by Electricians?
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be familiar with the materials used by electricians.

Just as there are many tools used by electricians, there are also many different kinds of materials used. By studying the materials shown below, you will learn to recognize many of the materials you will encounter if you choose to work in the residential electrician trade.

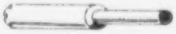
Electrical Materials

I. Types of Wire Conductors

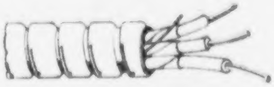
A. Nonmetallic cable (NM)



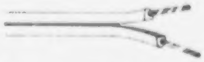
B. Thermal wire cable (TW)



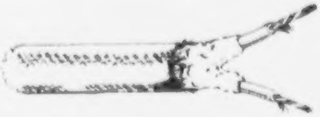
C. Metallic armored cable (BX)



D. Lamp cord (rubber or braided insulation)



E. Power service cord (SJ)

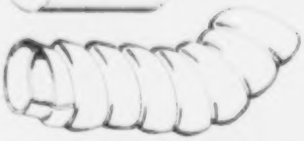


II. Types of Conduit

A. Thinwall (EMT) Electrical Metallic Tubing

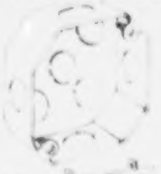
B. Rigid

C. Flexible

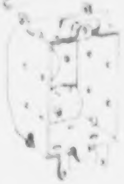


III. Types of Electrical Boxes (made of plastic or metal)--These boxes are used for splicing non-metallic cable as in junction boxes and for attaching switches, receptacles, and light fixtures.

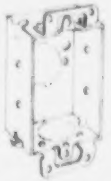
A. Octagonal ceiling or junction



B. Rectangular wall switch or outlet



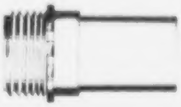
C. Shallow



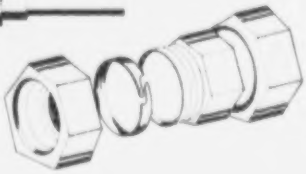
IV. Types of Electrical Connectors

A. Conduit connectors

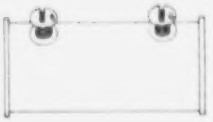
1. Indenter type



2. Compression type



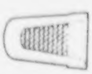
3. Coupler



B. Conductor connectors

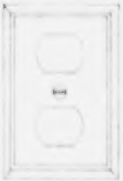
1. Wire nuts

2. MN wire connector

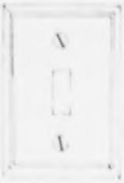


V. Types of Electrical Covers (plastic or metal)--These are used to safely cover switch and receptacle connections.

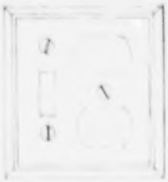
A. Duplex receptacle



B. Switch cover

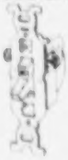


C. Combination duplex and switch



VI. Types of Switches--These are used to open and close circuits.

A. Single pole

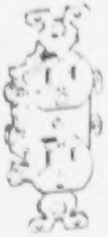


B. Three-way

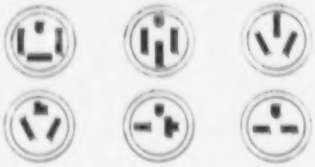
VII. Types of Outlets and Receptacles

A. Duplex with ground

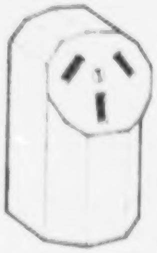
(NOTE: A duplex without a ground is not approved for use.)



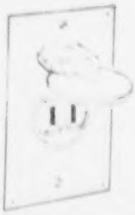
B. 208-240V



C. Surface mount 240V

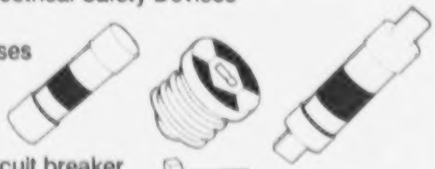


D. Weatherproof

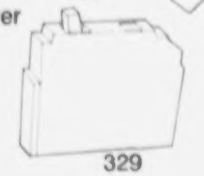


VIII. Types of Electrical Safety Devices

A. Fuses



B. Circuit breaker



ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:____ **DATE:**______________________

UNIT: Introduction to the Residential Electrician Trade

TOPIC: What Materials Are Used by Electricians?

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the electrical trade.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify materials used by electricians.

REFERENCE: Student Information Sheet/What Materials Are Used by Electricians?

DIRECTIONS: Your instructor will make a display of materials listed on Student Information Sheet/What Materials Are Used by Electricians? Each type of material will be assigned a number. On a sheet of paper, write the correct name for each type of material beside the number.

STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT: Fundamentals of the Residential Electrician Trade

TOPIC: Basic Electrical Circuits

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of the residential electrician trade.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to demonstrate an understanding of basic electric theory.

When working in the residential electrician trade, it is important that you understand how electrical circuits function and the basic laws that govern them. The word **electricity** is commonly used to mean the flow of electrons through a conductor, or the flow of current. There are two different types of current. One type, **direct current (DC)**, always flows in a continuous path in the same direction. The other type is called **alternating current (AC)** because the flow of current changes direction at regular intervals.

Direct Current (DC)

According to the modern electron-flow theory, in a direct current the flow of current is from a negative terminal to a positive terminal. In figure 1, a battery is used as the source of direct current. The symbol of a battery, as shown, has a short line representing the negative terminal and a long line at the bottom representing the positive terminal. The term load is used to represent any electrical device that will perform a task when the current is allowed to flow through it. You can tell by the direction of the arrows that as long as there is no break in the wire conductor (that is, the circuit is not "open"), the current will flow continuously from the negative to the positive terminal. The advantages of direct current is that it provides a consistent level of current because it does not lose efficiency due to a change in direction. Since alternating current continuously changes directions, a continuously changing magnetic field is created, which leads to inefficiency.

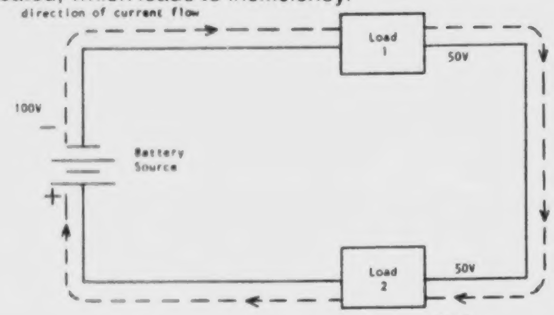


Figure 1. DC series circuit

Alternating Current (AC)

Certain disadvantages of direct current are overcome by the use of alternating current. When current must be moved a long distance-for example, from a large generating plant to various sections of large cities-it is more economical to use alternating current. For such a large network of electrical distribution, transformers must be used to step down and step up the levels of current and voltage that are needed. This is not possible with direct current. If direct current were fed into a transformer, no output current would be produced because direct current is continuous and constant in one direction only. Transformers require changes in current directions to effect a change in voltage.

The most common form of alternating current used in the United States is 60 cycles per second current, or 60 hertz (Hz), which means that the current travels from the AC power plant to the electrical consumer and back to the power plant 60 times in one second. In other words, it changes direction 120 times in one second. Figure 2 depicts this as an AC sine-wave curve.

The AC graphical representation in figure 2 is for the common 110-volt (V) household current. As the AC current leaves the AC generator at the power plant, the **voltage**--the force causing the current to move through conductive wires--climbs from zero potential to a peak of 110 V during the positive half cycle. This happens in the first quarter of the cycle. In the second quarter of the cycle, the voltage gradually decreases to zero potential. It then changes (goes negative) direction to begin the third quarter of the cycle. It gradually increases in value until it reaches the maximum or peak value of 110 V negative. In the last quarter of the cycle, the negative voltage gradually decreases, until it returns to zero potential and is ready to change direction and start a new cycle. Remember that it completes 60 of these complete cycles in one second. Whichever direction the current is going, whether it is the positive half cycle or the negative half cycle, it is providing electrical energy for use.

A DC voltage of 110 V will remain a constant value. There are no fluctuations once the switch is turned on from a DC electrical appliance. The voltage jumps instantly to 110 V and remains at the value until the switch is turned off, breaking the circuit. You can easily see why DC voltages are more efficient than AC voltages.

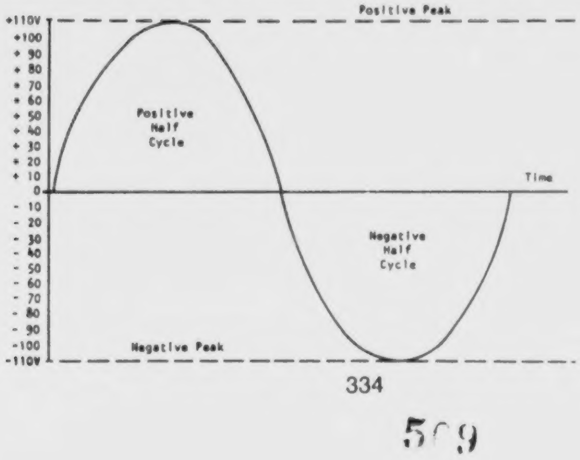


Figure 2. AC-voltage sine wave

ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:______________________________________ **DATE:**____________________

UNIT:	Fundamentals of the Residential Electrician Trade
TOPIC:	Basic Electrical Circuits
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of the residential electrician trade.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will demonstrate an understanding of basic electric theory.
REFERENCE:	Student Information Sheet/Basic Electrical Circuits
DIRECTIONS:	Read and answer each of the following questions in the space provided.

1. How many times does alternating current change in one second?

2. What is the advantage of using direct current instead of alternating current?

3. How is direct current different from alternating current?

4. What is the force that causes the current to move through the conductive wires?

5. What is the advantage of using alternating current instead of direct current?

RESIDENTIAL ELECTRICIAN TRADE

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STUDENT INFORMATION SHEET

RESIDENTIAL ELECTRICIAN TRADE

UNIT:	Fundamentals of the Residential Electrician Trade
TOPIC:	The Electron Theory and Ohm's Law
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of the residential electrician trade.
SPECIFIC OBJECTIVE(S):	After completion of this information sheet, the student will be able to discuss the electron theory and Ohm's Law.

If you have ever wondered what happens in a wire conductor to allow an electrical current to pass through it, you will find this assignment interesting. This question and other related questions will be answered. You should not only gain a better understanding of this process but also feel more confident working on electrical equipment after you have completed this assignment.

A basic law of charged bodies has been demonstrated many times in science classes. Two light pith balls are suspended near each other on threads. A hard rubber rod is rubbed, giving it a static negative charge. When the rod is placed against one of the balls, that ball receives more negative charge than the other one. The two balls will then be attracted together and stick together. This demonstrates that **unlike charges attract**. If the same charge is placed on both balls, then they swing away from each other on their threads. This demonstrates that **like charges repel**.

Ionization and Movement of Electrons

In a balanced atom of any solid matter, there are the same number of positive charges in the central nucleus as there are negative charges orbiting around the nucleus. The basic structure of an atom is illustrated in figure 1. When an atom loses or gains one or more electrons (negative charges), it is **ionized.** It becomes a **positive ion** if it has lost electrons and a **negative ion** if it has gained electrons. This process is called **ionization**.

In a metal conductor, the lighter electrons can be shaken loose from an atom and moved onto another atom (see figure 2). An electrical **current** is the movement of electrons from atom to atom through a conductor. These moving electrons are called free electrons. A good conductor is a metallic substance with some of its electrons so loosely bound to the nucleus that they are free to move from atom to atom. A poor conductor or **insulator** is a substance with few free electrons.

For current to flow in a wire conductor, it is necessary to cover the conductor with an insulator. The insulator restricts the movement of electrons. Good insulators are substances like mica, rubber, glass, dry air, asbestos, bakelite, and plastic. When the wire conductor has been covered with an insulator, the free electrons can only move backward or forward through the conductor. Before there can be a controlled movement of electrons through a wire in one direction, it is necessary to apply an electromotive force **(voltage)**. According to the widely accepted **electron theory**, electrons will move from a negative potential to a more positive potential through a conductor. The applied **voltage** causes an excess of electrons to gather at the end of the wire nearest the voltage source, the alternator or generator where the voltage is produced. Since like charges repel, these electrons set up a chain reaction much like lined-up dominoes falling against each other. Since there is also a more positive potential at the other end of the wire, the electron flow is attracted to move toward the more positive potential. This rate of electron flow is quite rapid because of the chain reaction. It travels at the rate of 186,000 miles per second.

Since the term **electromotive force** has been used to mean voltage, the letter E has become the most widely accepted symbol for voltage. Voltage can be measured in an electrical circuit with a voltmeter. The unit of measure for voltage is the **volt** (v).

Current Measurement

The unit used to measure a quantity of electrons is the **coulomb** (C). It was named after the French scientist Charles A. De Coulomb, who did a great deal of experimentation with charged particles of electricity. One coulomb has been taken to represent 6,242,800,000,000,000,000 electrons. The mathematical short form for this is 6.42×10^{18}. The number 6.24 is obtained by moving the decimal point eighteen places to the left. Each decimal place represents a power of ten. The rounded-off number, 6.24, is accurate enough for multiplication or division problems involving **Ohm's law**. The exponent 18 tells you how many times ten is used as a factor. For example, 10^3 is ten used three times, or 10 X 10 X 10. Therefore, $10^3 = 1{,}000$.

Letter symbols are substituted for the units of measure to solve Ohm's law problems later in this assignment. The letter symbol for current is the letter **I**. The current in a circuit can be calculated and then checked with the actual current measured with an ammeter. The unit of measure for electric current is the **ampere**, or amp. One amp is equal to one coulomb of electrons flowing past a given point in one second.

Ohm's Law

The residential electrician must be certain that the electrical and electronic circuits are operating properly in the equipment he or she installs and maintains. This means that it is necessary to be able to calculate the values of current (I), voltage (E), and resistance (R) that should be present at various points in the circuits. A basic law that must be used to do these calculations is called Ohm's law, named in honor of the nineteenth-century German scientist George Simon Ohm. A definite relationship exists between current, voltage, and resistance. If the voltage increases while the resistance remains the same,

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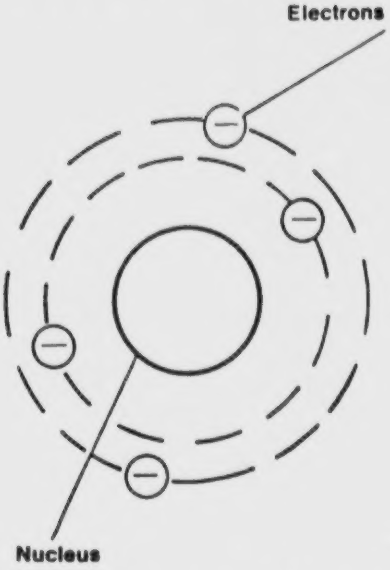

Electrons
Nucleus

Figure 1. Structure of an atom

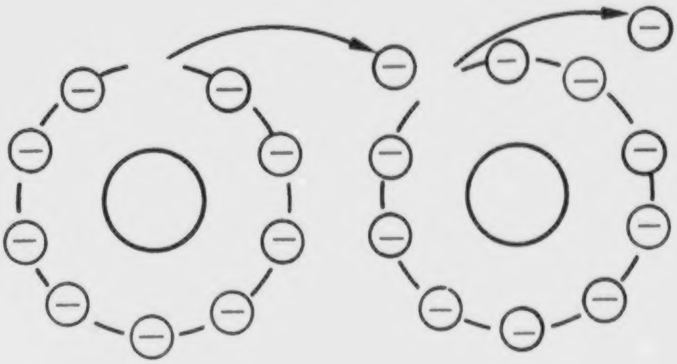


Figure 2. Movement of electrons between atoms

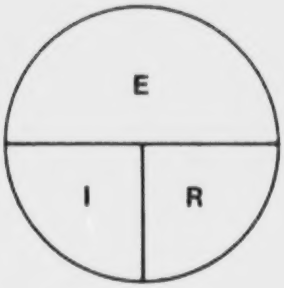


Figure 3. Memory device of Ohm's-law equations

then the current will also increase. If the voltage decreases, then the current will decrease. A decrease in resistance will cause an increase in current. The basic Ohm's law formula is

$$\text{I (in amps)} = \frac{\text{E (in V)}}{\text{R (in }\Omega\text{)}}$$

This means that the current in a circuit is equal to the applied voltage divided by the resistance. A good way to remember the three formulas derived from Ohm's law is to use the memory device shown in figure 3. To find the value of E, I, or R, place your finger over the unknown quantity, and the formula will appear. For example, if the unknown quantity is the voltage E, the formula would be $E = I \times R$, and the current in amps would be multiplied by the resistance in ohms. If the unknown quantity is the resistance R, the formula would be

$$R = \frac{E}{I}$$

and you would divide the voltage by the current.

A simple series-circuit problem is shown in figure 4. A 60-V battery (E) is connected to a load of unknown resistance. The current (I) is one amp. To find the value of R, you divide 1 amp into 60V. The answer is 60 Ω.

Power

Electrical power is measured in a unit called the **watt**. You can calculate the amount of power (P) using the memory device shown in figure 5, a pie chart that really spells PIE. To find the unknown value, you must know the value of the other two quantities, as in Ohm's law problems. If the current (I) and voltage (E) are known, then:

$$P + I \times E$$

The two other formulas to find the power use the square of a number, which is a number multiplied by itself. When the resistance (R) and current (I) are known, then:

$$P = I^2R$$

When the voltage (E) and resistance (R) are known, then:

$$P = \frac{E^2}{R}$$

Remember that there is a definite relationship between electrical power, current, and voltage. When one watt of power is consumed, one ampere of current has been forced through a circuit by the force of one volt. When solving any problem by using a formula, be sure all of the quantities are given in a consistent form. For example, when power is given in kilowatts, a conversion must be made to watts before attempting to solve a problem if voltage is given in volts (not kV) and resistance is given in ohms (not kΩ).

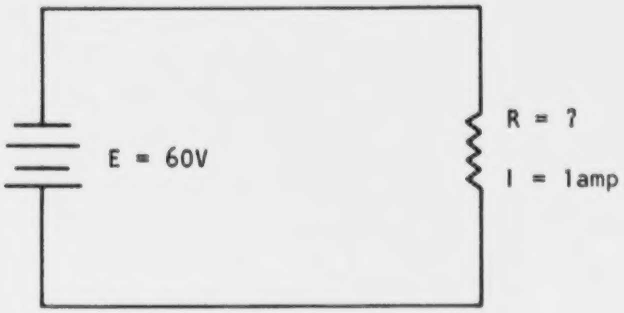


Figure 4. Series circuit to find resistance

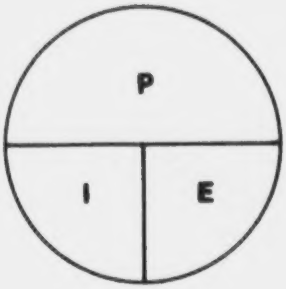


Figure 5. Memory device for power equations

ASSIGNMENT SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:____ **DATE:**______________________

UNIT:	Fundamentals of the Residential Electrician Trade
TOPIC:	The Electron Theory and Ohm's Law
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of the residential electrician trade.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will demonstrate a knowledge of the electron theory and Ohm's law.
REFERENCE:	Student Information Sheet/The Electron Theory and Ohm's Law
DIRECTIONS:	Using information provided in Student Information Sheet/The Electron Theory and Ohm's Law, correctly complete each of the sentences below.

1. A wire conductor must be covered with an ______________ in order to restrict the movement of electrons.
2. Current is measured with an __________________.
3. An applied voltage causes an excess of electrons near the ___________________ source.
4. The ________________ is the unit of measured power.

JOB SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:____ **DATE:**______________________

UNIT: Working in the Residential Electrician Trade

NAME OF JOB: Wiring a Light and Single Pole Switch Circuit

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in the residential electrician trade.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to wire a light and single pole switch circuit.

TOOLS AND EQUIPMENT: Practice board with empty device box and empty octagon box, single pole switch, light socket, 120v supply line, 120v incandescent bulb, long nose pliers, pocket knife, wire strippers, safety glasses

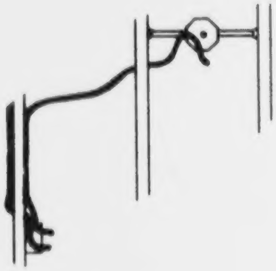
MATERIALS: 12-2-G or 14-2-G NM cable, wire connectors

GENERAL INSTRUCTIONS: Start by checking to see that you have all the tools, equipment, and materials required. Before you begin working, put on the safety glasses.

PROCEDURES AND/OR TASKS: Using the following steps, wire the light socket and single pole switch.

STEPS:

1. Remove the KO's from boxes if they are still in place.
2. Run cable between device box and octagon box as shown below.

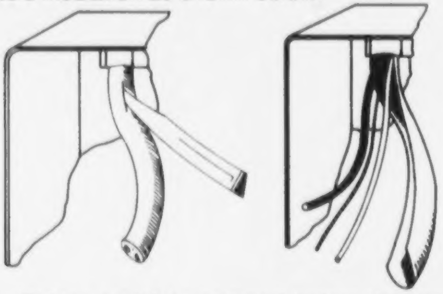


(NOTE: Leave at least 8" extending past the surface of your device and lighting boxes.)

3. Staple cable within 12" of all metal boxes, 8" of all nonmetallic boxes.

   (NOTE: Cables should be run flat when possible.)

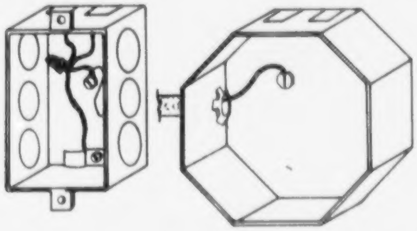
4. Strip cable insulation as shown below.



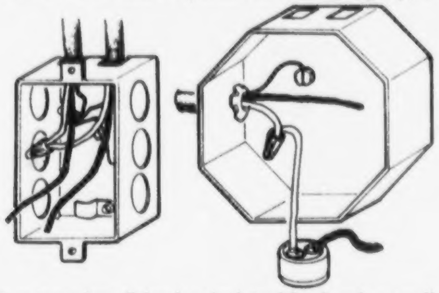
   (NOTE: Cables could be stripped before they are installed in the boxes. Cable covering may be trimmed to within 1/4" of its point of entry.)

   (**CAUTION**: Use extreme care when using a knife.)

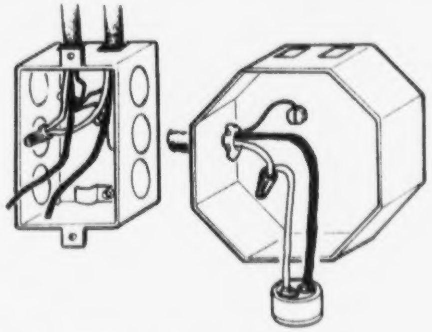
5. Connect all ground wires (green or bare) shown below.



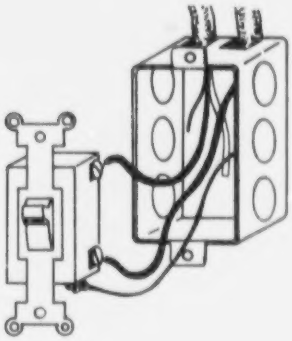
6. Connect all neutral wires (white or natural gray) as shown.



7. Connect return leg (black wire) to black wire on light socket.

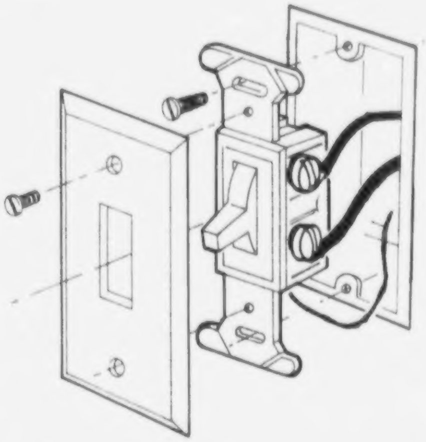


8. Connect switch as shown below.



(NOTE: Be sure that the loop in the black conductor wires is turned in the direction that the terminal tightens (clockwise).

9. Install switch in box.



10. Connect light socket to octagon box.

11. Have instructor check your work.

12. Clean work area.

13. Store tools properly.

JOB SHEET

RESIDENTIAL ELECTRICIAN TRADE

NAME:____ **DATE:**______________________

UNIT: Working in the Residential Electrician Trade

NAME OF JOB: Practicing Simple Electrical Troubleshooting

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in the residential electrician trade.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to do simple electrical troubleshooting.

TOOLS AND EQUIPMENT: Neon tester, practice box designed by instructor for this exercise

MATERIALS: No materials needed

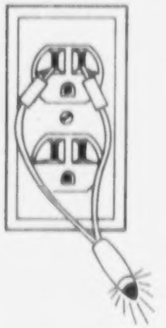
GENERAL INSTRUCTIONS: The residential electrician is often required to correct or repair faulty or malfunctioning electrical systems. There are no set steps which can be followed that will work in every situation; however, there are procedures which will be helpful.

(CAUTION: You must always be aware of safety procedures. Most of the time you will make sure the circuit has been turned off before starting work; however, when troubleshooting it is sometimes necessary to test circuits with the power on.

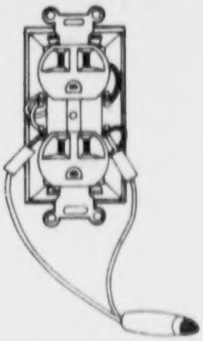
PROCEDURES AND/OR TASKS: Follow the steps to test the receptacle in order to determine the problem.

STEPS:

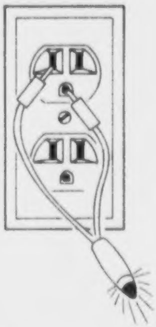
1. Insert leads of neon tester into slots of receptacle. If the tester light glows, circuit and receptacle are all right. If the tester light fails to glow, proceed to the next step.



2. Remove wall plate. Using neon tester, check the line conductors for voltage to receptacle. This is done by touching each lead of the neon tester to each terminal screw. If the tester light glows, the receptacle is defective and must be replaced. If the tester light fails to glow, proceed to the next step.



3. At times an open neutral conductor in the receptacle may be the cause of the problem. You test for this by placing one lead of the neon tester in the hot conductor (small slot of the receptacle) and the other lead of the tester in the ground slot. If the tester light glows, this indicates that the neutral is open.



4. If the tester fails to glow at steps one or three, this indicates that an open circuit is the problem. The open circuit may have occurred somewhere along the circuit wire (possibly at a previous box) or at the distribution panel.

5. Check with your instructor to determine if you have found the problem.

6. Return equipment to proper storage area.

SECTION V

PAINTING AND DECORATING

STUDENT INFORMATION SHEET

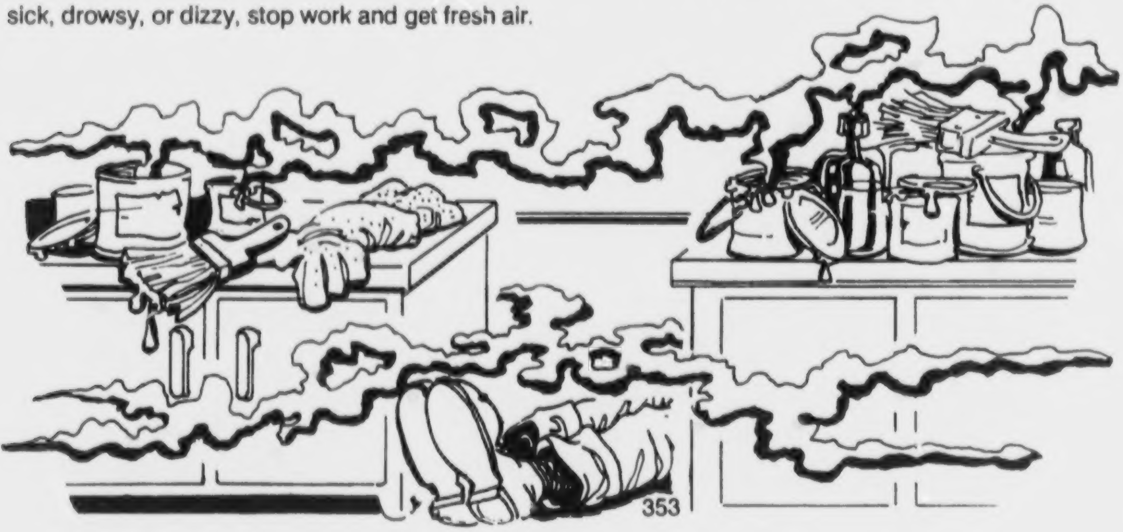
PAINTING AND DECORATING

UNIT:	Safety
TOPIC:	Painting Safety
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to identify safe working practices.

Safety is important in all areas of the construction field. Some areas have specific safety rules which apply to that area. Painting is one of these areas. Painters and decorators use many different types of solvents and paints. You should be aware of the special safety precautions used when working with these materials.

Paints and Solvents

When working with solvents and paints, make sure you are in a well-ventilated area. Solvent vapors are heavier than air and can travel long distances close to the floor. Solvents should not be placed in large, open containers when in use. You should wear protective clothing to avoid solvents or paints from coming in contact with your skin. Some paints contain lead, which is harmful to your health if it gets into your body. Solvents may cause skin irritation. If solvent is spilled on your clothes, you should change into clean, dry clothes immediately. Do not place solvent-soaked rags in your pockets. Painting safety involves being alert to yourself and your surroundings. Never use or store solvents or paints near heat or open flame. Also be aware of how you feel. If when using solvents or paints you begin to feel sick, drowsy, or dizzy, stop work and get fresh air.



ASSIGNMENT SHEET

PAINTING AND DECORATING

NAME: ____________________ **DATE:** ____________

UNIT: Safety

TOPIC: Painting Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify safe working practices.

REFERENCE: Student Information Sheet/Painting Safety

DIRECTIONS: Read each of the following statements carefully. Circle the T or F to indicate if the statement is true or false.

T F 1. There are specific safety precautions which must be used when working with solvents and paints.

T F 2. Room ventilation is not important when working with solvents or paints.

T F 3. Solvent vapors are heavier than air and can travel long distances close to the floor.

T F 4. Solvents should be placed in large, open containers when in use.

T F 5. Some paints contain lead, which is harmful to your health if it gets into your body.

T F 6. You should never use or store solvents or paints near heat or open flame.

T F 7. If when using solvents or paints you begin to feel sick, drowsy, or dizzy, stop work and get fresh air.

T F 8. Solvent-soaked rags should be kept in your pocket for easy access.

T F 9. Solvents may cause skin irritation.

T F 10. You should wear protective clothing to avoid solvents or paints from coming in contact with your skin.

STUDENT INFORMATION SHEET

PAINTING AND DECORATING

UNIT: Introduction to Careers in Painting and Decorating

TOPIC: Occupational Information

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements for painters and decorators.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. identify employment/career opportunities for painters and decorators, and
2. identify training requirements for painters and decorators.

Duties

Painters and decorators may do various types of painting and decorating. However, the majority will specialize in one or more areas. They may choose interior work, exterior work, new construction, or remodeling on certain types of buildings or structures. The work may be in the area of special effects and decorative designs or paperhanging. The basic job duties are similar regardless of the specialized area. The painter/decorator must determine from employers or customers the type and color of paint to be used, prepare surfaces for painting, and set up equipment such as ladders or scaffolding. They must also cover nearby areas or objects with plastic or canvas to protect them from dust or paint and use the appropriate method of painting. Then they must clean the tools, equipment, and area when the job is finished.

Employment/Career Opportunities

Many painters and decorators work for contractors in new construction work or in remodeling or repair of existing buildings. Some painters work on maintenance crews for factories, government agencies, hotels, hospitals, etc. Others are self-employed, operating their own businesses. As painters and decorators gain experience and skill, their earnings increase. Salaries for construction painters range from $9.00 to $26.00 per hour. Self-employed painters earn an average of under $15,000 to $40,000 or more per year depending on the demand for their services.

The job outlook for painters/decorators will vary with the changes in the economy, interest rates, availability of mortgage money, and the demand for new buildings. The competition for painting/decorating jobs in the area of new construction may be keen. This is due to the slowdown of new construction in many areas of the country. However, the job outlook for painter/decorators to work on existing buildings is better.

Training Requirements

Individuals interested in painting and decorating should take advantage of high school courses in mathematics, art, business, and vocational subjects. Knowledge in the use and care of hand and power tools is also recommended. Coursework in mechanical drawing would be helpful in reading blueprints and other building instructions.

It is possible for a painter/decorator to obtain job skills through informal on-the-job training. However, a three-year apprenticeship program for painters is recommended. Decorators would also benefit from schools and colleges which offer coursework in decorating.

ASSIGNMENT SHEET

PAINTING AND DECORATING

NAME:______________________________ **DATE:**____________________

UNIT: Introduction to Careers in Painting and Decorating

TOPIC: Occupational Information

UNIT OBJECTIVE: After completion of this unit, the student wil be able to understand employment/career opportunities and training requirements for painters and decorators.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. identify employment/career opportunities for painters and decorators; and
2. identify training requirements for painters and decorators.

REFERENCE: Student Information Sheet/Occupational Information

DIRECTIONS: Read each of the following statements carefully. Circle the T or F to indicate if the statement is true or false.

T F 1. Although painters and decorators do various types of painting and decorating, they usually specialize in one or more areas.

T F 2. Painters work only in the area of new construction.

T F 3. The basic job duties of painters/decorators are similar regardless of the specialized area.

T F 4. Many painters and decorators work for contractors.

T F 5. Some painters work on maintenance crews for factories, government agencies, hotels, hospitals, etc.

T F 6. Salaries for construction painters range from $4.00 to $10.00 per hour.

T F 7. Most jobs for painters will be in the area of new construction because of the increase in the number of new buidings.

T F 8. Knowledge in the use of hand and power tools is important for painters and decorators.

T F 9. Individuals interested in painting and decorating should take advantage of high school courses in mathematices, art, business, and vocational subjects.

T F 10. It is impossible for a painter/decorator to obtain job skills through informal on-the-job training.

STUDENT INFORMATION SHEET

PAINTING AND DECORATING

UNIT: Introduction to Painting and Decorating

TOPIC: Tools and Equipment

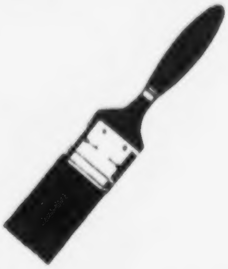
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with painting and decorating.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify tools and equipment necessary for painting, drywall finishing, and paper hanging.

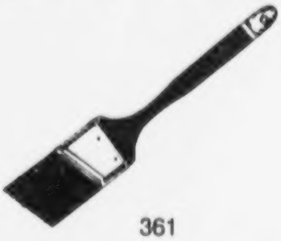
Painting Tools

Paintbrushes come in a variety of sizes, shapes, and materials. The type of paintbrush you will use will depend on the job you are doing. The bristles in a paintbrush also vary depending on what the brush is used for. Natural hair bristles such as swine hair, camel hair, and horse hair are used with enamel, oil-based paints, stains, and varnishes. Fiber bristles are made of rice root or straw and are used for caustic paints and texturing. Synthetic or nylon bristles are man-made from petroleum and are used in all types of paints.

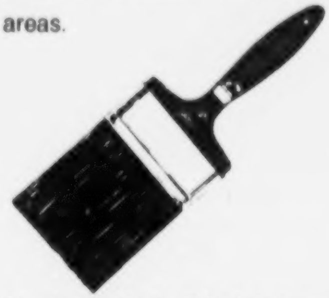
Just as there are a number of types of bristles, there are also different types of brushes. Flat sash and trim paintbrushes are 1 to 3 1/2 inches in width or wider. They are usually made with natural hair or nylon bristles. Flat sash and trim brushes are used for finish work on small areas.



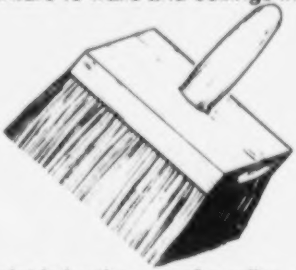
The angular sash paintbrush is 1 to 3 1/2 inches in width. It also is made with natural hair or nylon bristles. The angular sash paintbrush is used for fine finish work and especially tight corners.



Wall paintbrushes are 3 1/2 inches or wider. They are usually made with nylon bristles. Wall paintbrushes are used for large, flat areas.



The strippling paintbrush is 2 inches wide by 5 inches long or larger. It is made with fiber bristles. The strippling brush is used to apply texture to walls and ceilings in decorative patterns.



Another method of applying paint is by the use of a roller. Paint rollers come in various sizes and shapes. Flat wall rollers are usually 7 to 9 inches wide. Corner rollers are usually made of foam plastic. Trim rollers are 2 to 4 inches wide. Pipe rollers are split rollers on a curved frame. Commercial rollers are used for very large areas and are usually 18 to 14 inches wide. Roller covers are used on rollers to produce various paint effects. A short nap produces a smooth finish while a long nap produces a rough finish. Roller cover may be made of sheepwool, mohair, or synthetic material.

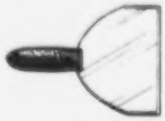
In order to paint surfaces out of reach, the painter uses a roller handle. Wooden handles are threaded to screw into the roller frame and are made in 48 to 60 inch lengths. Extension handles are made of aluminum tube, have two or three extension sections, and can be 6 to 24 feet in length. When painting with a roller, roller pans are used to hold the paint.

In addition to paintbrushes and rollers, painters use power tools and equipment. Compressed air sprayers and airless sprayers are also used to apply paint.

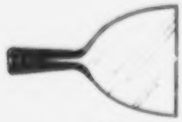
Before painting an area, the painter is responsible for cleaning and preparing the surface to be painted. Hand scrapers are used to remove cracked, blistered, and peeling materials from wall surfaces. Wire brushes with steel bristles are use to remove dirt and loose material from wall surfaces. The painter may choose to use power tools for cleaning an area. Electric sanders, wire wheel brushes, sandblasters, torches, and power washers are often used in preparing surfaces for painting.

Drywall Tools

Painters and decorators may be responsible for finishing out drywall. Tools used in finishing drywall fall into two groups: knives and trowels. The different types of drywall knives serve different purposes. Utility knives have a razor blade cutting edge and are used to cut and trim drywall materials. The joint knife is usually 4 or 5 inches wide. It is used to bed tape and holes. Corner knives are usually 6 inches wide with square corners on the blade. A corner knife is used to bed and float tape. Also used is the angle knife. The angle knife is usually 3 inches wide and is used for work in tight corners. In addition to the above, painters may use a broad knife. The broad knife is 6 inches x 24 inches and is often used in the place of a trowel.

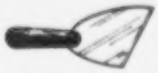


CORNER KNIFE

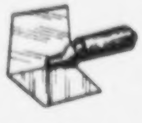


JOINT KNIFE

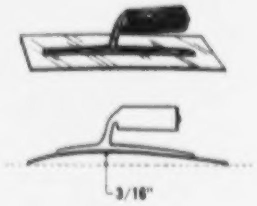
UTILITY KNIFE



ANGLE KNIFE



CORNER TROWEL



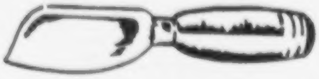
JOINT TROWEL

The other group of tools, trowels, also come in different types. The joint trowel is 14 inches long by 4 inches wide with a 3/16 inch concave curve in the blade. The joint trowel is used to apply finish coats of texture over taped joints. Corner trowels are double bladed and are used to float inside corners.

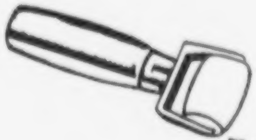
Paper Hanging Tools

You may not always need all the tools listed. However, having the right tools will make the job of hanging paper easier.

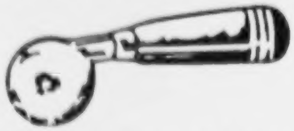
Paper knife--is used for cutting and trimming wallpaper.



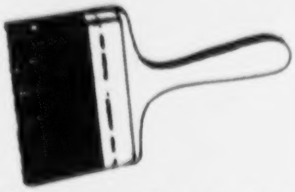
Seam roller--helps make edges of paper stick more firmly. This helps to produce a neater, longer-lasting job.



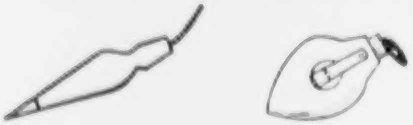
Wheel knife--is for trimming paper around baseboards, casements, wall switches, etc. Paper that is set with paste is hard to cut with an ordinary knife, but this knife will cut it.



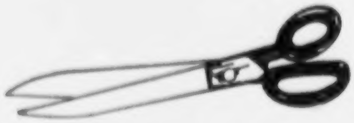
Paste brush--Most wallpaper is prepasted; however, some will require paste. The paste brush is used for spreading paste evenly and smoothly. A better quality brush is recommended. It lasts longer, is easier to use, and is easier to keep clean.



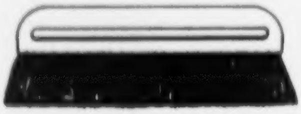
Plumb bob and chalk line--are used to help hang wallpaper strips straight.



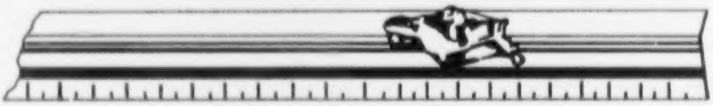
Wallpaper shears--are used for cutting wallpaper strips. These also serve as a good extra pair of scissors.



Smoothing brush--sweeps out air bubbles and wrinkles that a cloth cannot. For easier handling and longer use, your better quality brush is suggested.



Trimming outfit--A straight edge and trimmer trims paper accurately. While not necessary for a "one-roomer," this is a wise investment for the "whole-house" and is a must for the professional paperhanger.



ASSIGNMENT SHEET

PAINTING AND DECORATING

NAME:____ **DATE:**______________________

UNIT: Introduction to Painting and Decorating

TOPIC: Tools and Equipment

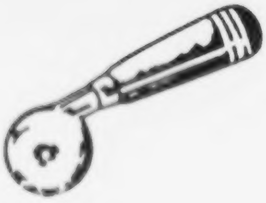
UNIT OBJECTIVE: After completion or this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify tools and equipment necessary for painting, drywall-finishing, and paper hanging.

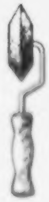
REFERENCE: Student Information Sheet/Tools and Equipment

DIRECTIONS: Look carefully at each of the following drawings of tools and equipment. Correctly identify each by placing the correct letter in each blank.

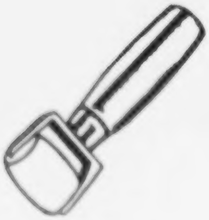
A. Angular sash paintbrush
B. Flat sash and trim paintbrush
C. Paint roller
D. Corner knife
E. Seam roller
F. Joint trowel
G. Airless sprayer
H. Paste brush
I. Corner roller
J. Strippling paintbrush
K. Roller handle
L. Corner trowel
M. Wheel knife
N. Roller pan
O. Wallpaper shears



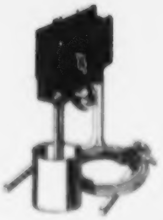
1. ____________



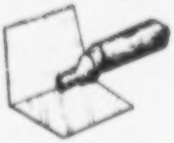
2. ____________



3. ____________



4. ____________



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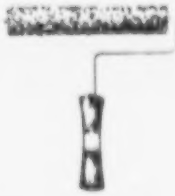

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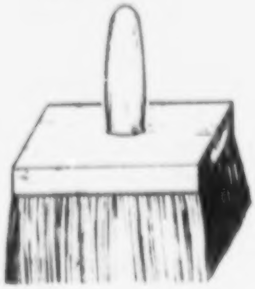

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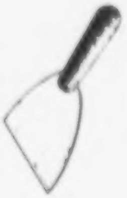

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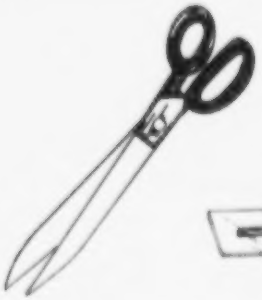
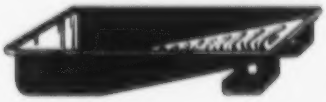
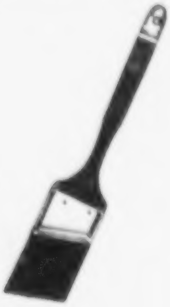


9. ____________

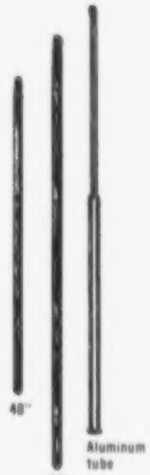
10. ____________



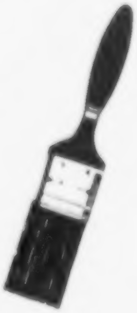
11. ____________



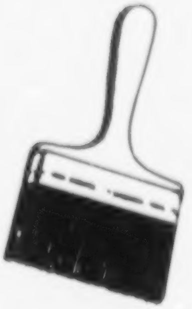
12. ____________


48''
60''
Aluminum tube

13. ____________



14. ____________



15. ____________

JOB SHEET

PAINTING AND DECORATING

NAME:________________________________ **DATE:**________________________

UNIT: Introduction to Painting and Decorating

NAME OF JOB: Using Painting and Decorating Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to use a painting and decorating tool.

TOOLS AND EQUIPMENT: Display of painting and decorating tools.

MATERIALS: No materials are required

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Select one tool from the display.
2. Using proper safety procedures, demonstrate how the tool should be used.
3. Replace the tool.

STUDENT INFORMATION SHEET

PAINTING AND DECORATING

UNIT: Introduction to Painting and Decorating

TOPIC: Learning About Materials

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with painting and decorating.

SPECIFIC OBJECTIVE(S): After completing the information sheet, the student will be able to identify materials for painting, drywall finishing, and paper hanging.

Painting Materials

Painters and decorators are responsible for making sure that surrounding areas are protected against damage from paint and painting equipment. Drop covers made of cotton ducking are used to protect floors from paint droppings and splatter. Plastic tarps, which are simply large plastic sheets, are used where waterproof protection is needed. Painters and decorators also provide furniture covers to protect furniture.

Paint cloths are also important for the painter. Canvas cloths are made of coarse cotton material and are used to rub stain on wood. Cheesecloth is a soft cotton material with open weave. It is used to wipe stain onto wood. Terry cloth is a thick, soft cotton material with looped pile. It is used to wipe up spills and smears. A word of caution - **Store used paint cloths in metal, airtight containers to prevent fires.**

Painting materials also include consumable materials (materials which are used up). These materials are paints (both oil-based and water-based), stains, varnishes, cleaning solvents, and thinners.

Drywall Materials

Materials used for drywall-finishing include joint compounds and perforated paper tape. A non-asbestos joint-compound is used for covering reinforcing tape, nails, metal corner beads, and drywall trim. It is also used for filling, leveling, and finishing coats, coating entire panel surfaces, and for applying simple textures. Joint compound may be premixed in a box or can come in a powder to be mixed with water.

Perforated paper tape is simply paper tape containing small holes which is used to cover drywall joints that are to be bedded.

Paper Hanging Materials

Few materials are used in paper hanging. The wallpaper is selected by the contractor or customer. At times, it may be necessary to apply wallpaper paste. While most wallpaper is pre-pasted, some will require the use of paste. Wallpaper paste may be purchased in the powder form to be mixed with water; however, most pastes are now pre-mixed.

ASSIGNMENT SHEET

PAINTING AND DECORATING

NAME:____________________________________ **DATE:**____________________

UNIT: Introduction to Painting and Decorating

TOPIC: Learning About Materials

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with painting and decorating.

SPECIFIC OBJECTIVE(S): In completing the assignment sheet, the student will identify materials for painting, drywall finishing, and paper hanging.

REFERENCE: Student Information Sheet/Learning About Materials

DIRECTIONS: Look at the materials displayed by your instructor. Each material has a number assigned. List each number on a sheet of paper and correctly identify the materials. Tell if each is used for painting or drywall finishing or paper hanging.

STUDENT INFORMATION SHEET

PAINTING AND DECORATING

UNIT: Fundamentals of Painting and Decorating

TOPIC: Basics of Color

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be familiar with the basics of color, including the psychology, selection, and styling.

Psychology of Color

Emotionally, people are affected by color. A knowledge of the psychological effects of color is important to anyone entering the field of painting and decorating. Individual preferences for color often change through life. Colors which appeal to one age group may have another effect on another age group.

There are generally accepted reactions to color which are important when selecting colors. Blue is thought to be both sedative and cool. However, if blue is used too much or too often, it may produce a feeling of melancholia or sadness. Green, like blue, is thought to be both cooling and sedative. Yellow demands attention; it is cheery and stimulating. The color red stimulates the brain; it is often associated with violence and excitement. Purple is seen as sedative and soothing. Orange, which has a stimulating effect, should be used in relatively small amounts. Gray and brown are often depressive unless used with livelier colors. White is thought of as cheerful, especially when used with red, yellow, or orange.

Selection of Color

Care should be used when selecting colors. You may select what you like for your own home. However, when selecting colors for a public or commercial building, care should be taken to select colors which will be attractive to a majority of the people who will use the building. Deep colors make walls of a room appear heavy, while pale pastel colors make the walls appear light. The size of the room and type of lighting should be considered when selecting color.

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Styling

When a color scheme is being designed, certain problems may arise. Decisions will have to be made regarding what will be suitable for the client. Questions such as these should be asked: Shall the walls be pale or deep in color? What parts of the room are to be light, medium, or dark in value (for contrast)? Shall the color scheme be cool, or warm, or neutral? An interior space can be made beautiful in itself, but it will not necessarily complement the people who will use it. It takes skill to create a beautiful, restrained, and integrated colored space which will reflect well on those who use it.

ASSIGNMENT SHEET

PAINTING AND DECORATING

NAME:____ **DATE:**______________________

UNIT: Fundamentals of Painting and Decorating

TOPIC: Basics of Color

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be familiar with the basics of color, including the psychology, selection, and styling.

REFERENCE: Student Information Sheet/Basics of Color

DIRECTIONS: Read each of the following statements. If the statement is true, circle the T; if false, circle the F.

T F 1. A knowledge of the psychological effects of color is important for painters and decorators.

T F 2. People are not affected emotionally by color.

T F 3. Colors which appeal to one age group may have a negative effect on another age group.

T F 4. Gray and brown are often depressive unless used with livelier colors.

T F 5. Blue and green are thought to be both sedative and cool.

T F 6. The color red stimulates the brain and is often associated with violence and excitement.

T F 7. White is thought to be depressive.

T F 8. The size of the room and type of lighting should be considered when selecting color.

T F 9. When selecting colors for a pubic or commercial building, you should depend on your personal taste.

T F 10. Individuals' preferences for colors remain the same throughout their lifetime.

STUDENT INFORMATION SHEET

PAINTING AND DECORATING

UNIT:	Fundamentals of Painting and Decorating
TOPIC:	Understanding Painting and Cleanup Procedures
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to demonstrate an understanding of painting and cleanup procedures.

Painting

Painting a surface and cleaning tools and equipment appears to be very simple. There are steps which should be followed, however, in order to do the job correctly.

Before you start the painting job, spread paint cloths and covers over floors and furniture or surrounding areas which need to be protected. Check the surface to be painted. If you are painting new wood, be sure to apply a prime coat before painting. If you are re-painting a previously painted surface, repair any damaged areas prior to painting. When re-painting existing structures, it is helpful to remove switch plates and electrical outlet covers. You should also mask any windows, molding, lights, and other surfaces which are not to be painted.

After the surface is ready and final preparations have been made, mix the paint according to the directions on the paint container.

The ceiling should be painted first. Begin by painting the corners of the ceiling. Paint around trim work, such as molding. If trim is to be painted with the same paint, do so at this time. After the area around the trim has been painted (painting the corners and around the trim work before the larger surface is called **cutting in**), paint the large area of the ceiling. Be sure to paint the ceiling in the same direction in which it was primed.

Walls should be painted next. Remember to "cut in" the corners and around the trim work before painting the walls. The walls should be painted from the top to the bottom. If the walls need a second coat of paint, wait until the first coat has dried. Some paints will cover a surface with one coat.

Window sashes, door facings, and doors are painted next. This type of painting is usually done with a brush. Most painters like to use a semigloss or gloss paint on the trim work. After the trim work has been painted and while the paint is still wet, use a brush to make long, straight, light strokes on the painted surface.

Baseboards should be painted last. Use cardboard or masking tape to prevent paint from getting on the wall surface or floor. When using masking tape, be sure to remove the tape as soon as the surface is painted. If masking tape is left on the surface too long, it will take up the new paint when it is pulled off. Drop cloths should be kept away from baseboards until the paint has dried.

Cleanup Procedures

When you finish painting, tools should be cleaned immediately using the correct cleaning solvents. Water-based paint may be removed from tools by using mild detergent and water. When using any type of soap, be sure to rinse thoroughly with water. Put all unused paint back into the correct cans and close the lids tightly. When paint has dried, take up drop cloths and store them in the proper place. Replace any switch plates and outlet covers which have been removed. All masking tape should be removed. Check carefully to see if any paint has been dropped on windows, floors, etc. If there is any, remove it. All equipment should then be stored away correctly.

ASSIGNMENT SHEET

PAINTING AND DECORATING

NAME:______________________________ **DATE:**____________________

UNIT:	Fundamentals of Painting and Decorating
TOPIC:	Understanding Painting and Cleanup Procedures
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will demonstrate an understanding of painting and cleanup procedures.
REFERENCE:	Student Information Sheet/Understanding Painting and Cleanup Procedures
DIRECTIONS:	Read each statement below. If the statement is true, circle the T; if false, circle the F.

T F 1. You should spread cloths and covers over the floor and furniture before painting.

T F 2. There is no need to prime new wood.

T F 3. Take off any switch plates and electrical covers before painting.

T F 4. Be sure to follow directions on the can when mixing paint.

T F 5. Large surfaces should be painted before corners.

T F 6. Trim work, such as molding, should be painted around before painting the large surface next to it.

T F 7. Painting the corners and around the trim work before the larger surface is called "cutting out."

T F 8. You may apply the second coat of paint before the first coat of paint has dried.

T F 9. Paint always covers the surface on the first coat.

T F 10. Baseboards should be painted last.

T F 11. All types of paint can be removed from tools using soap and water.

T F 12. Unused paint should be put back into the correct can and lids closed tightly.

T F 13. The painter should replace any switch plates and outlet covers which have been removed during the painting process.

T F 14. The painter is not responsible for any paint which may have dropped on windows, floors, etc.

T F 15. All tools and equipment should be stored correctly when the job is completed.

JOB SHEET

PAINTING AND DECORATING

NAME: ______________________ **DATE:** ______________________

UNIT: Fundamentals of Painting and Decorating

NAME OF JOB: Using Masking Tape

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate the ability to mask a window for painting.

TOOLS AND EQUIPMENT: Window

MATERIALS: Masking tape

GENERAL INSTRUCTIONS: Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Clean the window.
2. Using masking tape, correctly mask all areas of the window which should not be painted.
3. Have your instructor check your work.
4. Remove the masking tape.
5. Replace the equipment and materials.

STUDENT INFORMATION SHEET

PAINTING AND DECORATING

UNIT: Fundamentals of Painting and Decorating

TOPIC: Drywall Finishing

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.

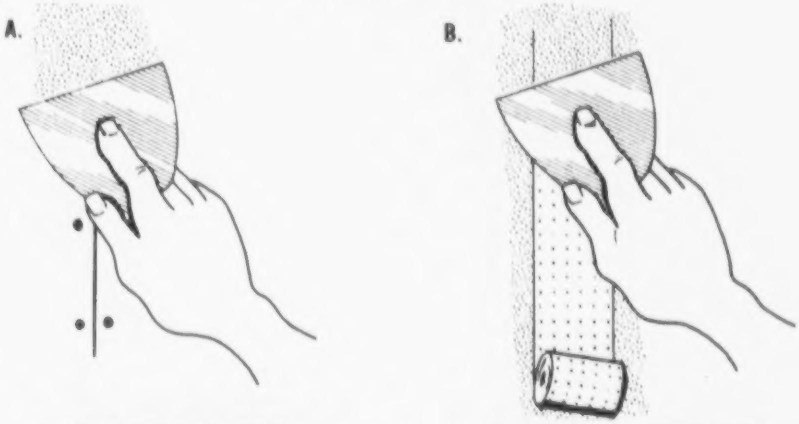
SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be familiar with the fundamental processes of drywall finishing.

Drywall finishing is a form of wall preparation. If the builder elects to use drywall (sheetrock) for wall covering, it is often the responsibility of the painter to finish the surface of the drywall. The sides of the sheet of drywall are tapered. In finishing the drywall, taping and bedding is done. The tapered sides of the drywall allow for the thickness of the tape and joint compound.

When finishing drywall, a bed of joint compound is applied on joints (where edges of drywall meet) and to the heads of any sheetrock nails used to hold the drywall in place. Perforated paper tape (tape with small holes in its surface) is bedded into the joint compound to cover joints. This provides for better insulation by sealing joints. It also provides a smooth, even wall finish.

After tape has been bedded into the joint, a thin layer of joint compound is applied to cover tape. Joint compound is smoothed out with a joint trowel. Excess joint compound is removed.

Specific drywall tools have been designed to assist in drywall finishing. Special knives and trowels are used for corner work and joint work.



A. FILL JOINT AND COVER NAILS WITH JOINT COMPOUND

B. EMBED THE PERFORATED TAPE IN JOINT COMPOUND

Figure 1. Taping and bedding

ASSIGNMENT SHEET

PAINTING AND DECORATING

NAME: ______________________________ **DATE:** ____________________

UNIT: Fundamentals of Painting and Decorating

TOPIC: Drywall Finishing

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be familiar with the fundamental processes of drywall finishing.

REFERENCE: Student Information Sheet/Drywall Finishing

DIRECTIONS: Read each of the following statements. If the statement is true, circle the T; if false, circle the F.

T F 1. Special drywall tools are designed to assist in finishing drywall.

T F 2. Taping and bedding provide for better insulation by sealing the joints.

T F 3. In finishing drywall, joint compound is applied only to the joints.

T F 4. A joint trowel is used to smooth out joint compound on joints.

T F 5. Taping and bedding provides a smooth, even finish to work with.

T F 6. A smooth, solid-surfaced tape is used in drywall finishing.

T F 7. Nail heads should be covered with joint compound.

T F 8. The builder is always responsible for drywall finishing.

T F 9. Sides of drywall are tapered to allow for the thickness of the tape and joint compound.

T F 10. Perforated paper tape is used in drywall finishing.

JOB SHEET

PAINTING AND DECORATING

NAME:__________________________________ **DATE:**____________________

UNIT: Working in Painting and Decorating

NAME OF JOB: Preparing a Surface for Painting

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will prepare a surface for painting.

TOOLS AND EQUIPMENT: Hammer (13 oz.), joint knife, joint trowel

MATERIALS: Joint compound, perforated paper tape, sandpaper, new drywall-covered wall

GENERAL INSTRUCTIONS: One of the most important factors in a good paint job is the proper preparation of the surface to be painted. Read each of the following procedures before beginning this job.

PROCEDURES AND/OR TASKS: When preparing a new interior wall for painting, the following procedures should be used.

1. Using the hammer, set all nails just below the surface to allow for bedding.

   (**NOTE**: Do not break the paper covering of the drywall when setting nails.)

2. Pull off all loose paper from edges of drywall sheets.
3. Sand all rough edges.
4. Prepare the joint compound according to container instructions.
5. Tape and bed all joints.

   (**NOTE**: Refer to figure 1 for details.)

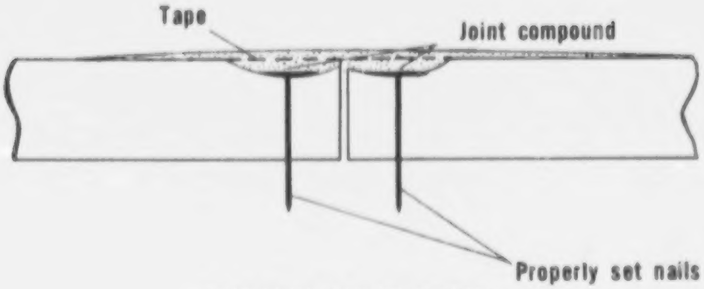
6. After first coat has dried, apply a second coat over joints.
7. Bed all nails.

   (**NOTE**: If any part of the joint knife touches the nail head, reset the nail.)

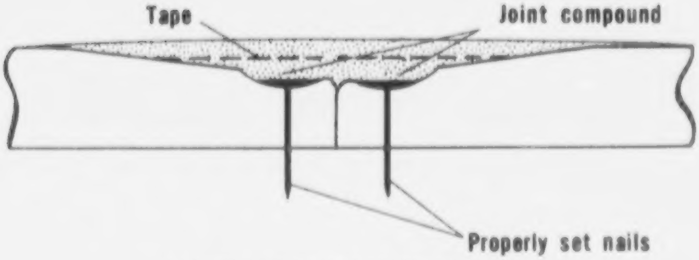
8. Float all joints.

9. Smooth all rough areas with sandpaper.

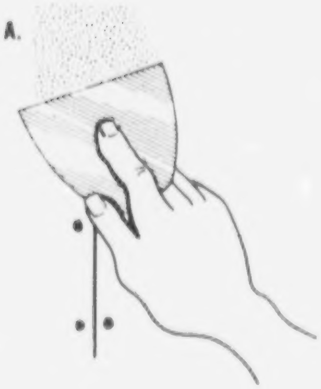
10. Clean and store tools properly.


Tape
Joint compound
Properly set nails

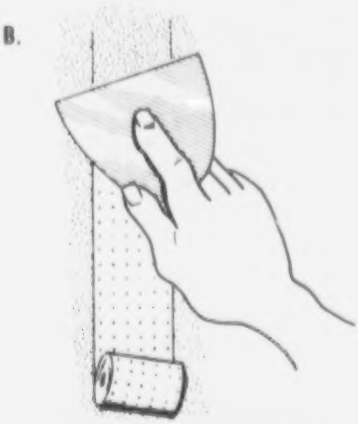
FLAT JOINT (END OF SHEETS)


Tape
Joint compound
Properly set nails

TAPERED JOINT (SIDES OF SHEETS)



A. FILL JOINT AND COVER NAILS WITH JOINT COMPOUND



B. EMBED THE PERFORATED TAPE IN JOINT COMPOUND

JOB SHEET

PAINTING SURFACES

NAME:________________________________ **DATE:**____________________

UNIT: Working in Painting and Decorating

NAME OF JOB: Painting Surfaces

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will paint, lacquer, or varnish wood, metal, or synthetic surfaces.

TOOLS AND EQUIPMENT: Flat paddle or shaker, clean container for mixing, paintbrush, roller, or sprayer

MATERIALS: Paint cloths and covers, paint (oil-based or latex), thinner or solvent (if necessary), surface to paint

GENERAL INSTRUCTIONS: Before you start to paint, make sure the surface has been properly prepared. Be sure that the area is well ventilated.

PROCEDURES AND/OR TASKS: Apply a finish coat of paint to the surface by using the following procedures.

1. Spread paint cloths and covers over floor and furniture if needed.
2. Sand all rough areas.
3. Remove sanding dust with clean, dry cloth or air nozzle.
4. Check putty and caulking.
5. Mask off any trim or areas not to be painted.

   (**NOTE**: If applying paint with brush or roller, masking may not be necessary.
6. Read directions on paint container and mix accordingly.
7. Apply paint using same procedure (brush, roller, or sprayer) used for primer coat.
8. Clean and store tools properly.

   (**Note**: Refer to Information Sheet/Understanding Painting and Cleanup Procedures for proper cleanup procedures.)

JOB SHEET

PAINTING AND DECORATING

NAME:____________________________________ **DATE:**____________________

UNIT: Working in Painting and Decorating

NAME OF JOB: Hanging Paper

UNIT OBJECTIVE: After completion of this unit, the student will be able to perform minor jobs in painting and decorating.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will demonstrate basic techniques of:

1. selection of materials;
2. estimation of materials;
3. preparation of surfaces; and
4. paper hanging.

TOOLS AND EQUIPMENT: Smoothing brush, wallpaper shears, paper knife, trowel, wallpaper samples, practice wall

MATERIALS: One roll pre-pasted wallpaper, joint compound, sandpaper

GENERAL INSTRUCTIONS: Read the information provided on selection and estimation of materials.

PROCEDURES AND/OR TASKS: Follow the steps below in order to complete this job sheet.

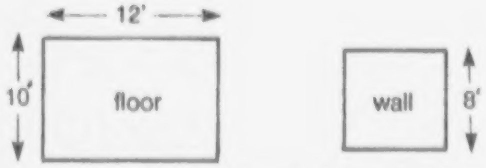
Selection of Materials

The selection of wallpaper is an important step in the wallpapering process. Wallpaper design and color must be considered. Keep in mind the type and colors of furnishings to be used in the room. Once you select a wallpaper pattern, make sure there is a sufficient amount of the same lot number to complete the job.

Estimating Materials

To find the approximate quantity of wallpaper needed for a room, measure the distance around the room, multiplying the total by the height of the room in feet. The results will be the gross area of walls in square feet.

Example:

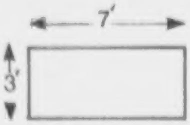


10' + 10' + 12' + 12' = 44x8 = 352sq. ft.

Next, measure doors and windows in the room. Multiply the height times the width for each.

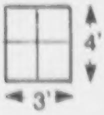
Example:

Door



3'x7' = 21sq. ft.

Window



3'x4' = 12sq. ft.

The next step is to subtract the number of square feet for each window or door opening from the total number of square feet in the room.

Example:

Room	352 sq.ft.
Door	-21 sq.ft.
Window	-12 sq.ft.
	319 sq.ft. of wallpaper needed

The standard measurement for a single roll of wallpaper is 20" wide and 24" in length. This gives a total area of 40 square feet. Wallpaper is manufactured in double rolls in order to avoid waste. A double roll of wall paper 20" wide and 48" in length would cover 80 square feet. In order to determine the number of rolls of wallpaper needed for a room, you would divide the total square feet of wallspace in the room by the number of square feet in a roll of wallpaper. (Some wallpaper comes in European measurements. A double roll covers approximately 57 square feet.)

Example:

```
                                7.9
number of sq.ft. in       40 )319.00  sq.ft. wall space
roll of wallpaper             280
                               390
                               360
                                300
```

You have 7 with a remainder, so you will need 8 single rolls or 4 double rolls of wallpaper.

STEPS:

1. Using the wallpaper samples provided by your instructor, select the wallpaper you wish to use.
2. As a means of gaining experience, measure, your classroom and figure the number of rolls of wallpaper you would need to cover the walls. Be sure to take into consideration doors and windows.
3. Prepare the surface of the practice wall as you did on Job Sheet/Preparing a Surface for Painting.
4. Hang one strip of wallpaper according to instructions on label of wallpaper.

SECTION VI

PLUMBING/PIPEFITTING

STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT: Safety

TOPIC: Personal Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify safe working practices.

There are hazards in all the construction and building trades. However, the frequency and severity of accidents in the plumbing trade are relatively low. The accident rate can be kept low by correcting unsafe conditions in the work area, using good judgment, knowing about systems and equipment, maintaining and using equipment correctly, and having a good attitude.

Many accidental injuries can be prevented by following safety rules and precautions. However, all accidents are not caused by human behavior. Some are caused by unsafe conditions in the work area. These unsafe conditions can usually be corrected. For example, a number of workers are killed or injured each year by deep ditch or trench cave-ins due to inadequate shoring or the lack of shoring. You should not work in a deep ditch or trench until it has been properly shored (figure 1). The following unsafe conditions may cause accidents.

1. Inadequate shoring or absence of shoring in deep trenches
2. Defective or improper use of tools or equipment
3. Hazardous footing caused by cluttered tools and materials, uneven surfaces, spilled oil, and similar situations
4. Not enough ventilation and light
5. Unsafe scaffolds, stagings, or ladders
6. Flying, falling, or moving objects

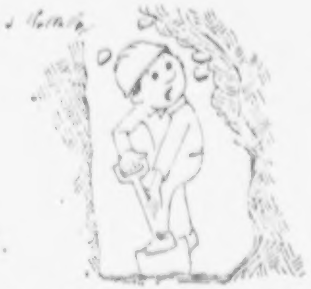


Figure 1.

Always shore trenches before working in them.

Good judgement is invaluable as you proceed with your work assignments, but you must have more than good judgment to perform your various jobs safely. You must have a knowledge of how systems and equipment operate, what elements of danger they present, and the tried and tested ways of protecting yourself and others against those dangers.

Approximately 80 percent of all accidents are the result of carelessness and lack of knowledge of correct operating and working procedures. Only a small percentage of injuries received by plumbers can be traced to failure of equipment. Nevertheless, equipment must be maintained in tiptop condition. Equally important are knowledge of the correct operating and working procedures and your attitude.

Developing wholesome attitudes toward safety is important if accidents and injuries are to be avoided. It is your job to want to be a safe worker, to appreciate the value of the safety equipment provided, and to understand the value of observing safety practices. On the surface this may appear to be a simple task. In practice, the task is far from simple, primarily because it often means that you must change attitudes or deeply rooted ways of thinking and doing things.

Carelessness in following safety regulations will lead to accidents, especially when no mishap has occurred for some time. Safety rules should be practiced until they become your work habits. A pair of goggles worn on the forehead during even the briefest instant of a grinding or chipping operation will not stop a flying particle heading for the eye. Goggles, shields, hard hats, safety shoes, rubber boots, safety belts, lifelines, respirators, and other such protective equipment should be worn when required as a safety measure for doing a job (figure 2). Personal protective equipment should be cleaned before it is stored or used.

Figure 2. Use proper safety clothing for the job you are doing.

Before you accept an assignment, assure yourself that you are physically and emotionally fit to perform the job in a safe and efficient manner. If you are ill or have received bad news from home and are unable to keep your mind on your work, you should notify your supervisor because your reactions are slower--a frequent cause of accidents. Mental alertness is of prime importance. You can only think clearly and keep your mind on your work when your mental condition is good.

Observe the following general personal safety rules.

1. Make "a clean shop is a safe shop" your motto.
2. Use proper safety clothing, shoes, gloves, goggles, hard hats, or respirators when required by special jobs.
3. Avoid horseplay.
4. Attend all safety meetings.

5. Do not wear loose garments, long sleeves, gloves, rings, watches, bracelets, or neckties that might be snagged by moving machinery parts if you are operating power machines (figure 3). Long hair capable of being snagged should be cut shorter or confined under a hat or cap. These items could get caught in the moving machinery. The result may be an injury to the operator or damage to the machine.
6. Always wear goggles during any grinding, chipping, jointing, sawing, or other operation that is dangerous to the eyes.
7. Before operating any machine, get permission from your supervisor to operate the machine. Read the operating instructions manual or get operating instructions from your supervisor. Make sure that you are familiar with all controls. Check that all appropriate safety appliances are in place and in operating order.
8. Never feed stock into a machine's cutting mechanism until you are sure that the stock will pass through freely.
9. Always stop any machine before adjustments or measurements are made to the stock or to the machine. This safety precaution will prevent possible damage to the machine and injury to the operator.
10. Keep hands away from moving and cutting mechanisms. Keep hands out of any position in which they might drop on or into the cutting mechanism.
11. Do not speak to anyone who is operating a power machine unless it is absolutely necessary. Talk distracts the operator's attention and can cause an accident.
12. Immediately report any injury--no matter how small--to your supervisor after you have tended to it.
13. Before proceeding into any dangerous situation, the basic general rule is to **STOP, LOOK, and THINK.**
14. Never remove scrap from an operating machine with your hands. Keep your hands away from moving and cutting mechanisms or other machine mechanisms.

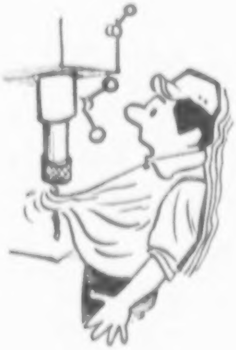


Figure 3. Never wear loose clothing around moving machinery.

ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME: ____ **DATE:** ______________

UNIT: Safety

TOPIC: Personal Safety

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will discuss safe working practices.

REFERENCE: Student Information Sheet/Personal Safety

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. Why should you not work in a deep ditch or trench until it has been properly shored?

2. What are the first things to do after being injured?

3. How should you protect your eyes during a grinding or chipping operation?

4. What precautions should be followed before personal protective equipment is stored?

5. Why should you never remove scrap from an operating machine with your hand?

6. What should you do before operating any machine?

7. Why is it important to keep floors around working areas clear of materials and waste pieces of stock?

8. Why should any machine be stopped before any adjustments or measurements are made on the stock or machine?

STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT: Safety

TOPIC: Safe Handling and Storage of Materials and Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. explain what good housekeeping means;
2. discuss rules for working safely;
3. tell what element causes most accidents; and
4. explain how to lift loads without injuring your back.

Good housekeeping means having a proper place to store everything and keeping everything not in use in its place. Good housekeeping rules are safety rules as well as appearance rules. Loose articles, litter, and the like may be tripped over. The person tripping over them may fall off a scaffold or against a spinning circular saw or cutterhead. Poor housekeeping also increases the danger of fire and makes firefighting measures less effective.

The use of good judgment can prevent accidents and damage to or loss of materials or equipment. Keep working spaces and aisles clear and safe. Learn to observe the following safety rules.

1. Place tools and materials where they cannot fall on everyone and where no one is likely to stumble over them. If materials must be piled, make the pile neat and compact.
2. Never lean tools or materials against a wall or other support that might give under the additional weight or against a support where they could be jarred loose.
3. When you leave a working space for a long time, store tools and other materials where they will not become a tripping hazard.
4. Wipe up any grease or oil spots in the working area to prevent a slipping hazard (figure 1).
5. Place all flammable materials, including greasy waste, oil-soaked rags, or paint-covered cloths, in an approved waste can for proper disposal because these items can cause spontaneous combustion.
6. If you must work on an icy or slippery surface, spread a layer of sand or ashes to ensure a firm footing.
7. Do not use gasoline as a cleaning agent (figure 2). For safety, it is best to use a low-hazard solvent.

8. Keep flammable liquids in safety cans equipped with self-closing covers.

9. Release the air pressure from the gasoline tanks of furnaces or torches after use and before putting them away.

10. Do not fill a furnace or torch while it is hot or start the blowtorch until the gasoline in the priming cup is almost consumed.

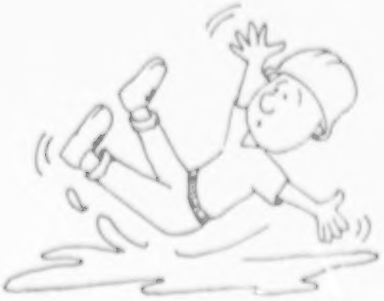


Figure 1. Clean up all grease or oil spills immediately.

11. All materials in bags, containers, or bundles and materials stored in tiers should be stacked, blocked, interlocked, and limited in height so that they will be stable and will not slide or collapse.

Surveys show that most accidents that occur during construction and maintenance operations happen in the course of handling materials. Handling by hand seems to produce more accidents than handling by mechanical equipment. Mechanical equipment, however, usually produces greater damage and more severe personal injury. Nevertheless, the human element is the basic cause of most accidents.

All people handling materials should wear approved safety shoes. The wearing of sandals, open-toed shoes, or thin-soled shoes should be avoided. Foot guards and leg guards should be worn when the nature of the material being handled makes such protection necessary.

Gloves should be worn when carrying, lifting, or moving objects that are sharp, splintery, or hazardous to the bare hands. Approved gloves, rubber aprons, acid-resistant boots, and goggles or face shields should be worn when handling acids, caustics, or strong solvents. Do not wear rings when handling materials.

Handling materials usually involves three activities--lifting, transporting, and storing. About 25 percent of all industrial injuries occur when handling materials. Most of these injuries could have been prevented if the people involved had used proper care in doing their jobs.

Before lifting a load, consider its weight, size, and shape. Then consider your ability to handle it. If the load is too heavy or too bulky, ask someone for assistance. If the distance is too far or the height to lift it is too high, ask someone to help you move it. Keep in mind that frequently handling loads may cause back strain or injury, even though the loads are well within your ability.

If you decide to move a load by yourself, follow these steps to prevent pulled muscles, disc lesions, or painful hernias (figure 3).

1. Place one foot alongside the load being lifted and the other foot behind the load. Spread the feet to give greater stability. This also puts the rear foot in position for the upward thrust of the lift.
2. Use the sit-down position and keep the back straight. Remember that straight does not mean vertical. Keeping the back straight holds the back muscles, spine, and organs of the body in correct alignment. This minimizes compression of the intestines, which can cause hernias.
3. Tuck your chin in so that your neck and head continue the straight back line. This helps keep the spine straight and firm.
4. Grip the load so that your fingers and palm extend around the object being carried. This gives you the most strength for carrying a load.
5. As you lift, keep your arms and elbows drawn into the side of your body. This gives you the most strength for lifting the load as well as keeping your body weight centered.
6. With your body weight centered over your feet, start the lift with a thrust of your rear foot. This provides the greatest amount of thrust and gives the best balance.
7. Lift the load into a carrying position, and do not turn or twist your body until you complete the lift.
8. Look over your path of travel, making sure it is clear. If you must change direction of travel, change your foot position. Do not twist your body.
9. Setting the load down is just as important as picking it up. Using your leg and back muscles, comfortably lower the load by bending your knees. When the load is securely positioned, release your grip.

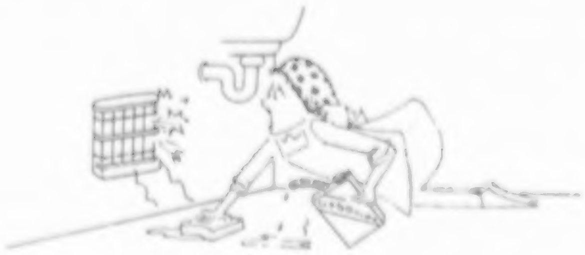
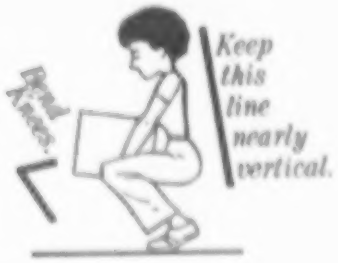


Figure 2. Do not use gasoline as a cleaning agent.

Figure 3. Lift bulky or heavy objects correctly.


Bend Knees.
Keep this line nearly vertical.

ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME: ______________________________ **DATE:** ______________

UNIT: Safety

TOPIC: Safe Handling and Storage of Materials and Tools

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of:

1. what good housekeeping means;
2. rules for working safely;
3. what element causes most accidents; and
4. how to lift loads without injuring your back.

REFERENCE: Student Information Sheet/Safe Handling and Storage of Materials and Tools

DIRECTIONS: Read each of the following statements carefully. Indicate if the statement is true or false by circling the T or F.

T F 1. You should always place oily rags, greasy waste, or paint-covered clothes in an approved waste can for proper disposal.

T F 2. Aisles should be kept clear at all times.

T F 3. Flammable liquids should be kept in open containers.

T F 4. Air pressure should be released from gasoline tanks of furnaces or torches after use and before putting them away.

T F 5. Gasoline should be used as a cleaning agent.

T F 6. When working on icy or slippery surfaces, you should spread a layer of sand or ashes to ensure a firm footing.

T F 7. It is best to use a low-hazard solvent as a cleaning agent.

T F 8. The human element is the basic cause of most accidents.

T F 9. You should bend your back when lifting a load.

T F 10. Your back should be kept straight when lifting a load.

JOB SHEET

PLUMBING/PIPEFITTING

NAME:____________________________ **DATE:**________________________

UNIT:	Safety
NAME OF JOB:	Using Personal Protective Equipment
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	In completing this job sheet, the student will demonstrate the ability to use personal protective equipment.
TOOLS AND EQUIPMENT:	Display of personal protective equipment.
MATERIALS:	List of plumbing/pipefitting jobs numbered from one to twenty.
GENERAL INSTRUCTIONS:	Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Pick a number in order to determine which job to prepare for.
2. Select the proper protective equipment which should be worn.
3. Demonstrate how the equipment should be worn.
4. Clean equipment if required.
5. Replace equipment.

STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT: Introduction to Careers in Plumbing/Pipefitting

TOPIC: Occupational Information

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in the piping trade.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. identify the basic jobs, specific tasks, and type of information that must be learned by plumbers and pipefitters;
2. discuss training given plumbers and pipefitters; and
3. discuss the job outlook and possibilities for advancement for plumbers and pipefitters.

Nature of the Work

Plumbers and pipefitters install pipe systems that carry water, steam, air, or other liquids or gases. They also alter and repair existing pipe systems and install plumbing fixtures, appliances, and heating and refrigeration units.

Although plumbing and pipefitting are sometimes considered a single trade, workers can specialize in either craft. Plumbers install water, gas, and waste disposal systems in homes, schools, factories, and other buildings. Pipefitters, on the other hand, install both high- and low- pressure pipes that carry hot water, steam, and other liquids and gases for use in industrial processes. For example, pipefitters install complex pipe systems in oil refineries and chemical processing plants.

In each of these trades, installation techniques are similar because they both involve pipes, faucets, and valves. Problems met in one trade are similar to those in the other.

Most pipes are copper, cast iron, or some other metal. Pipes may also be plastic, glass, or other nonmetalic material. Although some iron pipes come ready to install, other metal or plastic pipes may have to be "fitted" for the job. To fit pipes, workers may first have to measure, bend, cut, and thread pipes. Then they may have to bolt, braze, glue, screw, solder, or weld them together.

Some plumbers and pipefitters specialize in gas, steam, or sprinkler fitting. Gasfitters install and maintain the fittings and extensions that connect gasline mains with the lines leading to homes. Steamfitters assemble and install steam or hot water systems for commercial and industrial uses. Sprinkler fitters install and maintain the piping for fire extinguishing systems.

Plumbers and pipefitters use wrenches, reamers, drills, braces and bits, hammers, chisels, saws, and other hand tools. Power machines often are used to cut, bend and thread pipes. Hand-operated hydraulic pipe benders also are used. In addition, plumbers and pipefitters use gas or acetylene torches and welding, soldering, and brazing equipment.

Places of Employment

Most plumbers and pipefitters work for plumbing and pipefitting contractors engaged in new construction activity. They work mainly at the construction site. A large number of plumbers are self-employed or work for plumbing contractors doing repair, alteration, or modernization work.

Some plumbers install and maintain pipe systems for government agencies and public utilities. Some work on the construction of ships and aircraft. Others do maintenance work in industrial and commercial buildings.

Pipefitters, in particular, are employed as maintenance personnel in the petroleum, chemical, and food processing industries where manufacturing operations include the processing of liquids and gases through pipes.

Training, Other Qualifications, and Advancement

Apprenticeship is the best way for plumbers or pipefitters to learn all aspects of these trades. A large number of people, however, learn plumbing and pipefitting by working for several years as helpers to experienced plumbers and pipefitters and observing and receiving instruction from them.

Most apprenticeship programs for plumbers and pipefitters are sponsored through union-management agreements and usually consist of 5 years of on-the-job training, plus at least 216 hours a year of related classroom instruction. Subjects include drafting and blueprint reading, mathematics applicable to layout work, applied physics and chemistry, and local building codes and regulations.

On the job, helpers and apprentices begin with simple tasks such as carrying materials and cleaning up debris. In a short time, they learn to measure and cut pipe. Later they learn to bend, thread, and connect it. The most difficult way of connecting pipe is welding. This is taught toward the end of the training. In the final phase of training, helpers and apprentices may learn to estimate costs.

Applicants for apprentices or helper jobs generally are required to be at least 16 years old and in good physical condition. A high school or vocational school education generally is recommended. Courses in chemistry, general mathematics, mechanical drawing, physics, and shop are helpful. Applicants may be given tests to determine whether they have the mechanical aptitude required in these trades. To obtain a plumber's or pipefitter's license, which some communities require, individuals must pass a special examination to demonstrate knowledge of the trade and of local plumbing codes.

Some plumbers and pipefitters may become supervisors for plumbing and pipefitting contractors. Many go into business for themselves. As they expand their activities, they may employ other workers and become contractors. In most localities, contractors are required to obtain a master plumber's license.

Employment Outlook

Employment growth is expected to be fairly steady in the years ahead since plumbing and pipefitting are less sensitive to ups and downs in construction activity than are most other building trades.

For example, a large proportion of homes will have air-conditioning equipment, solar heating devices, and appliances such as washing machines and kitchen waste-disposal equipment. Chemical and petroleum refineries and coal gasification and nuclear power plants, which use pipe extensively in their processing activities, are expected to expand. This will create additional jobs for plumbers and pipefitters. Maintenance, repair, and modernization of existing plumbing and piping systems also will create employment opportunities.

Earnings and Working Conditions

Annual earnings of workers in these fields are among the highest in the building trades because plumbing and pipefitting are effected less by bad weather and changes in construction activity than are most other building trades.

Plumbing and pipefitting work is active and sometimes strenuous. These workers often must stand for long periods, and at times, they must work in cramped or uncomfortable positions. They risk the danger of falls from ladders, cuts from sharp tools, and burns from hot pipes. The injury rate for employees of plumbing, heating, and air-conditioning contractors has been about the same as the average for contract construction as a whole, but higher than the average for manufacturing.

Many plumbers and pipefitters are members of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada. Some plumbers and pipefitters who are contractors are members of the National Association of Plumbing-Heating-Cooling Contractors.

Sources of Additional Information

For information about apprenticeships or work opportunities in these trades, contact local plumbing, heating, and air-conditioning contractors. You might also contact a local of the union mentioned above, or a local joint union-management apprenticeship committee, or the nearest office of your state employment service or state apprenticeship agency.

For general information about the work of plumbers, pipefitters, and sprinkler fitters, write the following organizations:

National Association of Plumbing-Heating-Cooling Contractors
1016 20th Street, N.W.
Washington, D.C. 20036

National Automatic Sprinkler and Fire Control Association
P.O. Box 719
Mount Kisco, New York

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of
the United States and Canada
9012 Massachusetts Avenue
Washington, D.C. 20001

ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME: ______________________________ **DATE:** ________________

UNIT: Introduction to Careers in Plumbing/Pipefitting

TOPIC: Occupational Information

UNIT OBJECTIVE: After completion of this unit, the student will be able to understand employment/career opportunities and training requirements in the piping trade.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of:

1. the basic jobs, specific tasks, and type of information that must be learned by plumbers and pipefitters;
2. training given plumbers and pipefitters; and
3. the job outlook and possibilities for advancement for plumbers and pipefitters.

REFERENCE: Student Information Sheet/Occupational Information

DIRECTIONS: Read each of the following statements carefully. Indicate if the statement is true or false by circling the T or F.

T F 1. Plumbers and pipefitters install only new pipe systems.

T F 2. Plumbing and pipefitting is often considered a single trade.

T F 3. Plumbers install water, gas, and waste disposal systems in homes, schools, factories, and other buildings.

T F 4. Pipefitters install both high- and low- pressure pipes that carry hot water, steam, and other liquids and gases for use in industrial processes.

T F 5. Most plumbers and pipefitters are self-employed.

T F 6. Apprenticeship is the best way for plumbers or pipefitters to learn all aspects of these trades.

T F 7. Applicants for apprentice or helper jobs generally are required to be at least 16 years old and in good physical condition.

T F 8. On the job, helpers and apprentices begin by learning to bend, thread, and connect pipe.

T F 9. Plumbing and pipefitting are less sensitive to the ups and downs in construction activity than are most other building trades.

T F 10. Annual earnings of workers in plumbing and pipefitting are among the lowest in the building trades.

STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT: Being Your Own Boss

TOPIC: Owning a Plumbing Business

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will:

1. explain the types of work done by the two kinds of plumbing businesses;
2. explain the business responsibilities for licenses, taxes, bonds, etc.;
3. explain how contract payments are made; and
4. explain how small businesses save money.

Types of Business Ownership

A plumbing business can be set up in several ways. A sole ownership is the form used by most plumbers. The full responsibility for the company rests on one individual. No formal documents or agreements are necessary, and business and personal income may be the same for tax purposes.

A partnership agreement consists of individuals sharing responsibilities, liabilities, work, and profits. Many of these arrangements combine the plumbing knowledge of one person with the management abilities of another. A limited partnership usually consists of one person supplying the capital and the other operating the business.

A corporation involves more legal documents but gives tax and liability advantages. Business and personal income taxes are separated, which allows for tax advantages. If losses occur in a corporation, the owner or owners are liable only for a part of these losses. Capital can also come from stockholders. An attorney should be retained to draw up the legal documents.

Types of Plumbing Businesses

Plumbing businesses are generally divided into two groups. First, there are plumbing contractors who design and install plumbing systems in houses and buildings during the construction of the building. Contractors bid on jobs. The contractor does a materials take-off from plans or designs the water supply and drain, waste and vent (DWV) systems from plans and does a take-off from them. The contractor will visit the site to determine the amount of equipment and labor required to dig the trenches. The contractor will also look at the plans to determine the amount of labor required to complete the job. After estimating the cost of materials and labor for doing the job, the contractor submits a bid. The plumbing is done in three stages--roughing-in, topping-out, and setting fixtures. In some instances, a percentage of the bid price is paid after each stage is completed. In others, a single payment is made upon completion of the job.

The second group of plumbing businesses is service and repair. This type of business may do large jobs. However, the most common jobs are small ones in which a plumber and a helper repair leaky faucets, repair water closets, clean out sewer lines, etc. In this type of business, plumbers are paid for the service call, the time spent working on the job, and the supplies used to repair the plumbing system.

Licenses and Permits

In most cities, plumbers are required to obtain a license (builder's permit) before installing a new plumbing system or adding to an existing one. A plumbing inspector inspects the plumbing in each of the three stages.

Taxes

A person beginning a new business must obtain an employer's identification (EI) number from the Internal Revenue Service. This number is used on forms submitted.

Persons who live in states with sales tax laws must also submit these taxes periodically. Sales tax laws vary from state to state.

The business must pay federal unemployment taxes if it has paid wages of $1,500 or more in any calendar quarter and has had one or more employees on at least some portion of one day in each of 20 or more calendar weeks. The basic tax rate is 3.2 percent of the first $4,200 of taxable wages received by each employee. The actual rate to pay is much less because the federal government gives credit for unemployment taxes that are paid to the state government.

State unemployment taxes are usually based on the taxable wage base of a quarter. The rate of the tax charged is also usually determined by the employee's unemployment experience. In some states, the worker is also assessed through payroll deductions.

Some counties, towns, and cities impose other taxes. These include real estate taxes, personal property taxes, taxes on gross receipts of businesses, and unincorporated business taxes.

Insurance

Plumbers are required to purchase a minimum amount of insurance. This is designed to protect the property owner, the public, and the company from losses. All subcontractors must also be insured.

Workers's compensation covers liability if a worker is injured on the job. Some coverages also include driving to and from work.

Bonds

Often a contractor will have to purchase a performance bond. A performance bond is a guarantee that a job will be completed. If the job is not completed, the bonding company either has someone else complete it or pays an equal amount of money.

Contracts

No work should be performed without a binding contract. The contract should include the price of the completed project, terms of payment, services and specifications, time lines, liabilities, and guarantees.

Contracts are normally either the lump-sum or cost-plus type. A lump-sum contract specifies that the plumber will be paid a certain amount after completing the job. Even if the job costs more than the contractor had originally figured, the specified price remains.

A cost-plus contract specifies that the plumber is to be paid certain construction and labor costs, plus a certain dollar or percentage added for the contractor's profit.

Offices

A large company must have an office or offices to keep up with all the necessary paperwork. Smaller plumbing businesses may be housed in the plumber's home. In this case, someone must always be near the phone to handle business calls. Many plumbers use timesaving two-way radios. The base unit is installed in the home or in the office. The plumber or other workers in the field make contacts through the base unit. This eliminates time-consuming trips to various places.

Equipment

A person in the plumbing business must have a certain amount of equipment to successfully operate a business. Power equipment, hand tools, ladders, and other equipment may be required. Whatever equipment is needed and often used must be made available to the plumbers at the time it is necessary.

Personnel

When hiring new personnel, it is important that the plumber or plumber's helper be capable of doing the job. The selection of a new worker should be based on more than a hunch or a good first impression. A good personality is not the only qualification for a plumber to have.

The first step in evaluating potential employees is to check their backgrounds. An application form is the best source for some of that information. The applicant's education, training, experience, and qualifications are easily and quickly determined.

The applicant should be given a formal or informal interview. This gives the employer an opportunity to ask important questions about the applicant's knowledge of plumbing. It also gives the applicant an opportunity to ask questions.

Several steps should be kept in mind during the selection process.

1. Analyze the position.
2. Determine what abilities the employee must have to fill the job.
3. Study personal factors, such as age, education, and health of the applicant.
4. Write a complete job description.
5. Interview objectively.
6. Check all references.
7. Compile and review all information before making a final selection.

All employees should have an orientation period. The job should be explained in full. The employee should be given an overview of the company's rules and policies. During the training period, the employee should be given all the safety rules. Every effort should be made to make each employee safety conscious.

ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME: ______________________________ **DATE:** ______________

UNIT: Being Your Own Boss

TOPIC: Owning a Plumbing Business

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the concepts and skills associated with entrepreneurship.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. explain the types of work done by the two kinds of plumbing businesses;
2. explain the business responsibilities for licenses, taxes, bonds, etc.;
3. explain how contract payments are made; and
4. explain how small businesses save money.

REFERENCE: Student Information Sheet/Owning a Plumbing Business

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. Name the three ways the ownership of a business can be set up.

2. What is a limited partnership?

3. What kind of work do plumbing contractors do?

4. What are the three stages of plumbing when constructing a new building?

5. What kinds of jobs do service and repair plumbing businesses do?

6. What is the license called that must be obtained before installing new plumbing or adding to an existing plumbing system?

7. With what kinds of taxes must an employer be concerned?

8. What is the purpose of a performance bond?

9. What are the two types of contracts that a plumbing contractor may enter into?

10. Where are many smaller plumbing businesses housed?

11. What are seven steps to keep in mind during the selection of new employees?

12. What should you emphasize during the orientation period?

STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT:	Introduction to Plumbing/Pipefitting
TOPIC:	Plumbing/Pipefitting Tools
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with plumbing/pipefitting.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to identify tools used in plumbing/pipefitting.

No other factors distinguish a craftsman as much as the knowledge, care, and use of the tools of the trade. As a craftsman, you should know how to care for each tool as well as the safety considerations for each one. You should also know the correct manner of designating the types, sizes, and makes of the tools of your trade.

Most master plumbers would agree on three basic rules regarding the purchase, care, and use of plumbing tools.

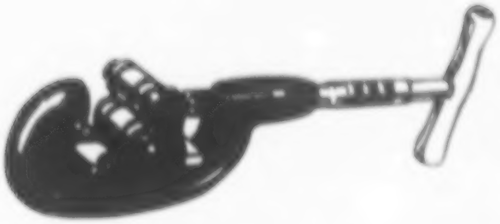
1. Purchase only quality tools.
2. Keep the tools in good condition.
3. Use the right tool for the right job.

There are many types of tools used in the plumbing/pipefitting trade. It would be impossible in a short period of time to learn all the uses of the various tools. However, in order to understand the types of jobs performed in plumbing/pipefitting, it is important that you become familar with the tools required and their basic function.

A brief statement is provided along with drawings of these tools. Study each picture along with each description. Being able to recognize and choose the necessary tools is important.

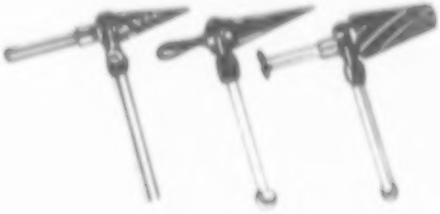
Pipe Cutters

Pipe cutters are used to cut steel or wrought-iron pipes. The tool is rotated around the pipe with the curved end of the tool partly encircling the pipe.



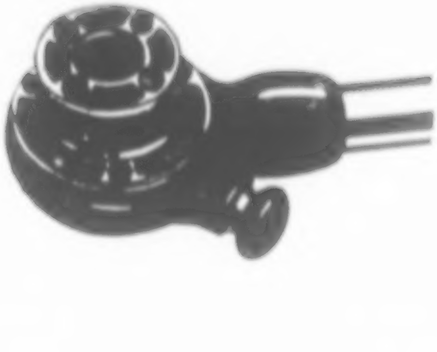
Pipe Reamers

Pipe reamers are used to remove burrs or sharp edges inside the mouth of a pipe.



Pipe Threaders

A pipe threader is used to cut new threads on pipe which has been cut to size.



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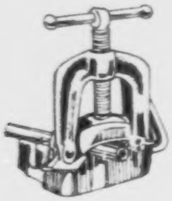
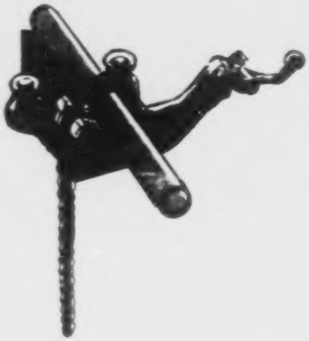
Pipe Vises

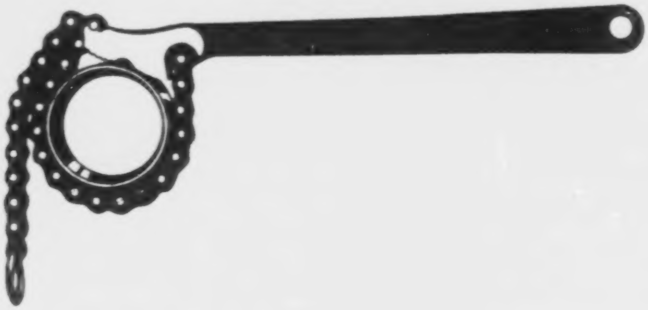
The two most common types of pipe vises are the yoke type, used for small pipes, and the chain type, used for large pipes.





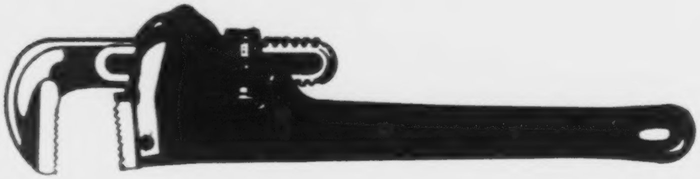
Chain Pipe Wrench

The chain wrench has a single or double fixed, toothed jaw and has an attached chain that fits around the pipe and connects to the other side of the jaw.



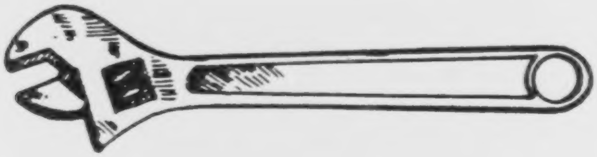
Straight Pipe Wrench

The straight pipe wrench has one toothed, ridged jaw at one end of the handle and one toothed, moveable outside jaw, which is adjusted by means of a knurled nut. The teeth on both jaws are designed to dig into the pipe as pressure is applied to the handle.



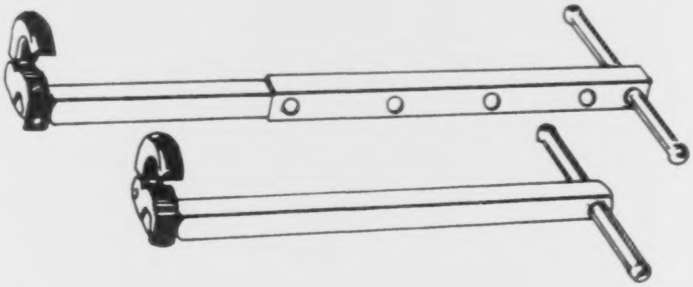
Adjustable Wrench

Adjustable wrenches have one adjustable lower jaw and one stationary upper jaw.



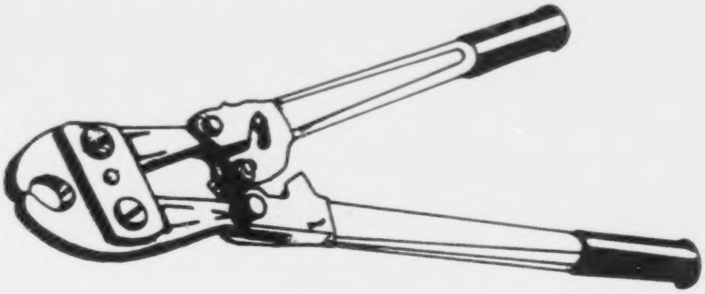
Basin Wrench

The basin wrench has a fixed, toothed jaw attached to the end of a shaft with a handle at the other end. A movable jaw is hinged to the fixed jaw. The fixed jaw pivots from one side of the shaft to the other to allow nuts or bolts to be turned to the left or right.



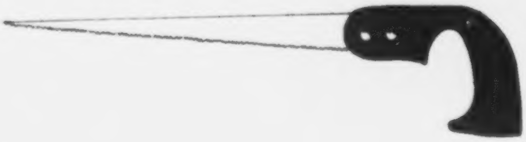
Crimping Tool

This tool is used to crimp rings around a fitting on polybutylene tubing.



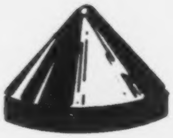
Compass Saw

Compass saws are light saws available in lengths from 10 inches to 16 inches.



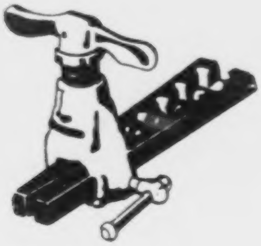
Deburring Tool

The deburring tool is a cone-shaped tool with cutting edges on both the inside and outside surfaces.



Flaring Tool

A flaring tool is used to form a flare on the end of copper tubing and on some plastic tubing.



ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME: ______________________________ **DATE:** ______________

UNIT: Introduction to Plumbing/Pipefitting

TOPIC: Plumbing/Pipefitting Tools

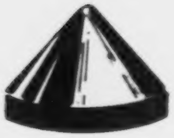
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify tools used in plumbing/pipefitting.

REFERENCE: Student Information Sheet/Plumbing/Pipefitting Tools

DIRECTIONS: Identify each of the plumbing/pipefitting tools shown by placing the correct letter in the blank.

A. Pipe cutter
B. Pipe reamer
C. Pipe threader
D. Flaring tool
E. Straight pipe wrench
F. Deburring tool
G. Crimping tool
H. Chain pipe wrench
I. Basin wrench
J. Adjustable wrench



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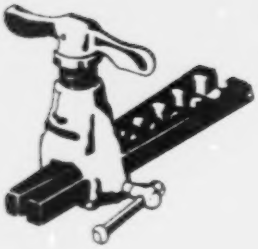

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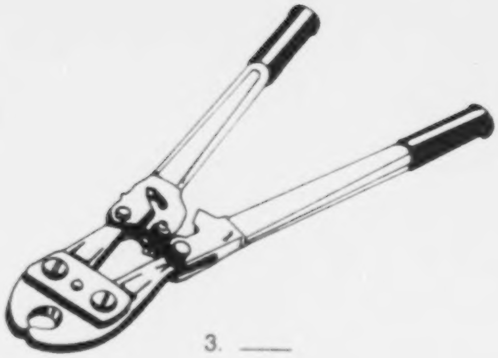

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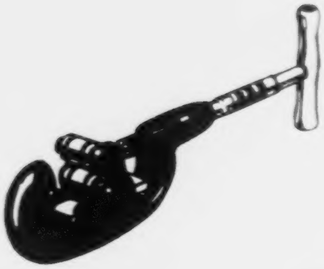

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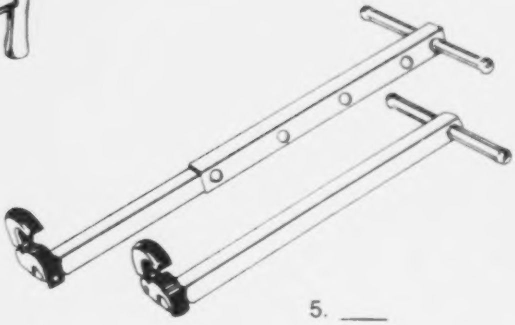

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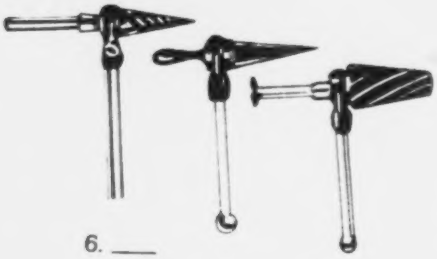

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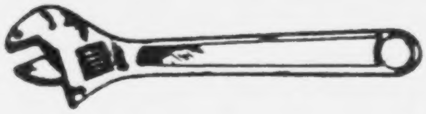

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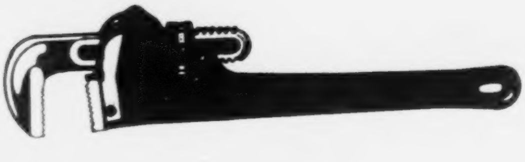

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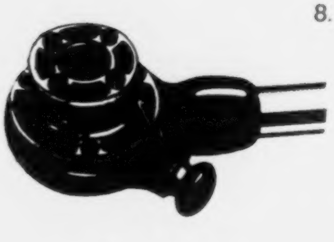

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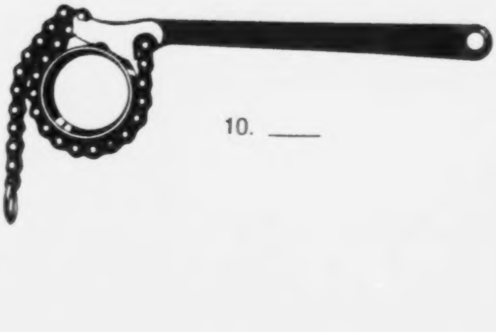

10. ____

JOB SHEET

PLUMBING/PIPEFITTING

NAME:______________________________ **DATE:**______________________

UNIT:	Introduction to Plumbing/Pipefitting
NAME OF JOB:	Using Plumbing/Pipefitting Tools
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with the plumbing trade.
SPECIFIC OBJECTIVE(S):	In completing this job sheet, the student will demonstrate the ability to use a plumbing/pipefitting tool.
TOOLS AND EQUIPMENT:	Display of plumbing/pipefitting tools.
MATERIALS:	No materials are required
GENERAL INSTRUCTIONS:	Follow instructions given in class.

PROCEDURES AND/OR TASKS:

1. Select one tool from the display.
2. Using proper safety procedures, demonstrate how the tool should be used.
3. Replace the tool.

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STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT: Introduction to Plumbing/Pipefitting

TOPIC: Materials Used in Plumbing/Pipefitting

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to identify materials used in plumbing/pipefitting.

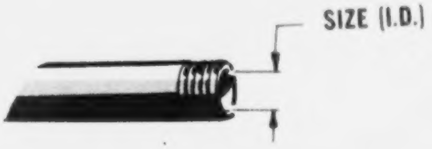
Pipe is made of many materials. Cast iron, wrought iron, steel, lead, brass, copper, and plastic are commonly used. Because pipe is used in many different ways, it must be supplied in many different sizes. Because it must meet many different conditions, pipe is made in several different ways from several different materials. Since iron was the first commonly used material for pipe, IPS (iron pipe size) is the term used to refer to pipe size, whether it is made of iron or steel.

Three factors are used to identify pipe: (1) its normal pipe size (NPS), (2) its wall thickness, and (3) the material used in its construction. The word nomenal means existing in name only. In other words, it is not an actual measurement but is some number near the actual measurement. It is within the allowable tolerance in making pipe.

The wall thickness of pressure pipe is usually referred to as regular (Schedule 40), extra-strong (Schedule 80), or double extra-strong.

Every length of pipe has three cross-sectional dimensions: (1) an outside diameter (OD), (2) an inside diamter (ID), and (3) a wall thickness. Of the two diameters, the OD is more important. When a pipe is joined to a fitting, the OD of the pipe must match the end connection of the fitting. For this reason, pipe manufacturers use certain standard measurements for these dimensions.

The wall thickness of the pipe used on a job is determined by the pressures the line must withstand in use. Pipe that will contain normal or relatively low pressures can be thin. Pipe in high-pressure service must have thicker walls. The higher the pressure, the thicker the pipe walls must be. Any given size of pipe, such as 3/4 inch, will have the same OD regardless of the pressure requirements. However, since high pressure pipe requires thicker walls, the ID will be smaller than for low-pressure or no-pressure service.



Steel Pipe

Steel pipe may be unfinished (black) or galvanized (zinc coated). Steel pipe is used for hot and cold water systems, steam and hot water heating systems, gas and air piping systems, and drainage and vent piping.

Plastic Pipe

In addition to steel pipe, there are various other types of piping available for use. Plastic pipe is widely used today. It has been around since the 1930's. PVC (Polyvinyl Chloride) is a rigid plastic pipe that is normally available in 20-feet sections. PVC pipe is ideal for cold water and drainage systems. CPVC (Chlorinated Polyvinyl Chloride) is a rigid plastic pipe that may be used for both cold and hot water systems. PE (Polyethylene) is a flexible pipe used primarily for drain, waste, and vent systems. ABS (Acrylonitrile-Butadiene-Styrene) is a rigid pipe approved for portable water systems. It is used for water supply systems and wells. One other plastic pipe available is PB (Polybutaylene). PB is a flexible pipe that is resistant to soaps, detergents, and most acids and bases up to 200° F. For this reason, it is used for both hot and cold water systems.

Copper Tubing

Copper is strong, lightweight, and corrosion resistant. It can be made flexible, which makes it easy to work with. For these reasons, copper is the most used metal in residential plumbing.

Cast-Iron Pipe

Cast-iron pipe is made of grey cast iron. It is used primarily for drain, waste, and vent systems.

ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME:____ **DATE:**________________

UNIT: Introduction to Plumbing/Pipefitting

TOPIC: Materials Used in Plumbing/Pipefitting

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify materials used in plumbing/pipefitting.

REFERENCE: Student Information Sheet/Materials Used in Plumbing/Pipefitting

DIRECTIONS: Carefully examine each piece of pipe provided by your instructor. Using the information provided in the Student Information Sheet/Materials Used In Plumbing/Pipefitting, identify the pipe and give an example of its use.

STUDENT INFORMATION SHEET

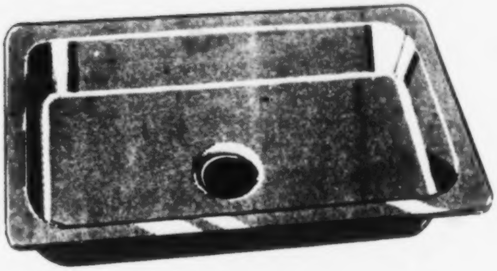
PLUMBING/PIPEFITTING

UNIT:	Introduction to Plumbing/Pipefitting
TOPIC:	Plumbing Fixtures
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with plumbing/pipefitting.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be able to identify various types of plumbing fixtures.

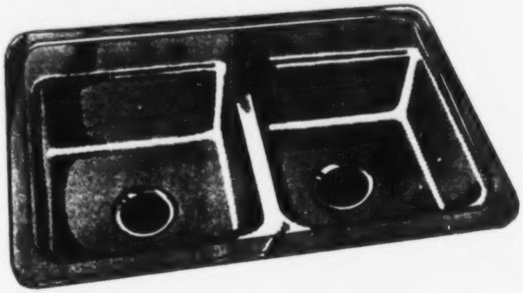
One of the responsibilities of the plumber is the installation of plumbing fixtures. The types of fixtures the plumber will install will vary according to the types of stucture being built. You should become familiar with these fixtures and the types of fixtures available, styles, types of materials, and finishes.

Kitchen Sinks

The kitchen sink may have a single compartment or a double compartment. It may have a flat rim or a ledge rim. Materials used in the construciton of kitchen sinks include vitreous china, a china made of very fine clay and finished with a glassy, slick surface; pressed steel, sheet steel that is pressed to shape acrylic plastic; fiber glass reinforced with plastic; or cast iron. Finishes or the surface of the sink may be stainless steel, white enamel, or colored enamel.



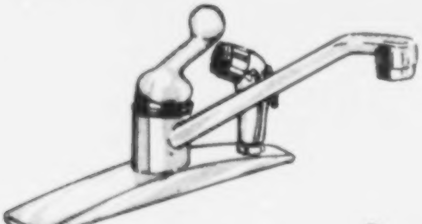
SINGLE COMPARTMENT-FLAT RIM



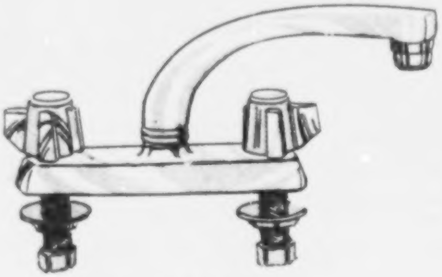
DOUBLE COMPARTMENT-LEDGE RIM

Types of Faucets

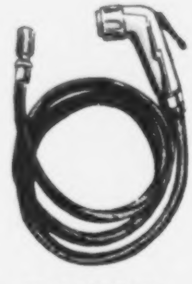
Sink faucets may be deck-mounted or wall-mounted. The water flow may be controlled by a single-handle or a double-handle. A dish spray is optional.



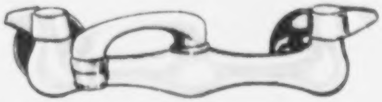
SINGLE-HANDLE DECK WITH DISH SPRAY



DOUBLE-HANDLE DECK



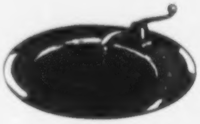
DISH SPRAY



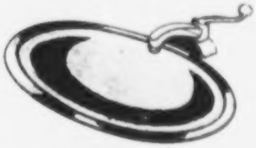
DOUBLE-HANDLE WALL

Bathroom Lavatories

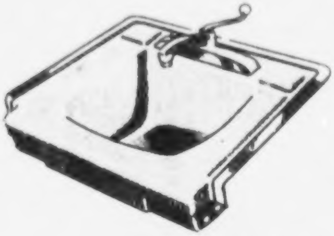
Lavatories may be installed in a countertop or may be wall-hung. Countertop lavatories come in many shapes--round, rectangular, oval, or three-sided. Wall-hung lavatories may have a ledge back or flat back. Like kitchen sinks, bathroom lavatories are available in vitreous china, pressed steel, acrylic plastic, fiber glass reinforced with plastic, or cast iron. Finishes include stainless steel, white enamel, and colored enamel.



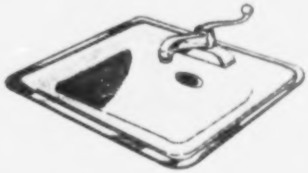
ROUND



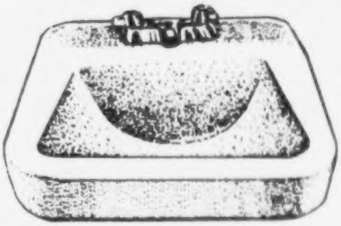
OVAL



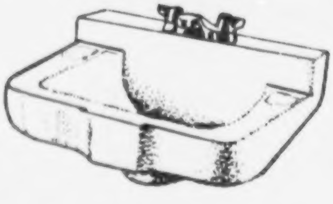
THREE-SIDED



RECTANGULAR



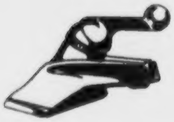
FLAT BACK



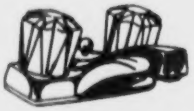
LEDGE BACK

Bathroom Lavatory Faucets

Bathroom faucets may be controlled by a single-handle or double-handles. In some cases separate faucets are used for hot and cold water.



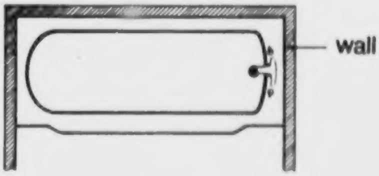
SINGLE HANDLE



DOUBLE HANDLE

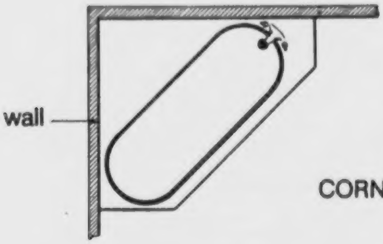
Bathtubs and Shower

Bathtubs come in many shapes and size. Recess bathtubs are enclosed by walls at both ends and back. Corner bathtubs are installed in the corner of the bath. The freestanding bathtub sits away from the walls. Also available is a tub-shower combination in one unit. Bathtubs are made of enameled cast iron, enameled steel, and fiber glass reinforced plastic.



RECESSED

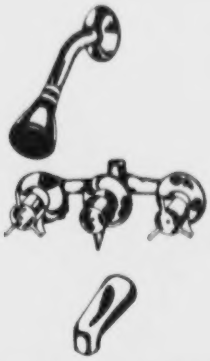
FREESTANDING

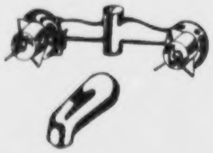


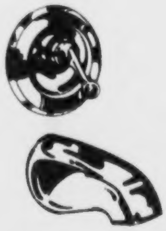
CORNER

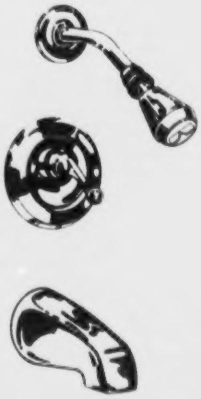
Faucets for Bathtubs and Showers

Faucets for bathtubs may be controlled by a double or single-handle. Faucets for a combination bathtub and shower will include a shower head and control.


SINGLE HANDLE WITH SHOWER

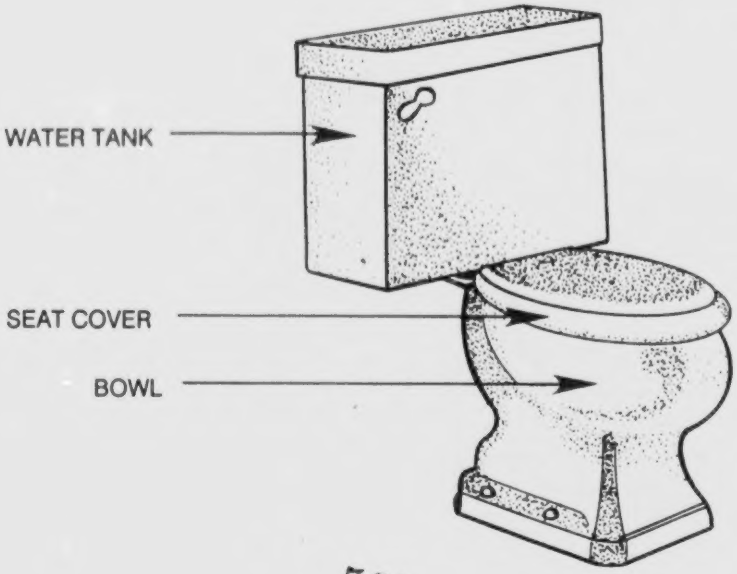

DOUBLE-HANDLE


SINGLE HANDLE


DOUBLE HANDLE WITH SHOWER

Water Closets

Water closets may be the washdown type in which water enters the bowl from around the rim or the syphon jet type where water enters the bowl from around the rim and below the water line. Both types of water closets come in round bowl, shallow bowl, and elongated bowl. Water closets are made of vitreous china and are finished in white or colored enamel. Water closets are available in a variety of styles. They may be wall-hung, the tank hung on the wall; closed-coupled, the tank mounted on the bowl; or one-piece, the tank and bowl are molded as one piece. Commercial or public buildings often use a vacuum flush water closet which has no tank. Water enters the bowl through a vacuum flush valve.



ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME:____ **DATE:**________________

UNIT: Introduction to Plumbing/Pipefitting

TOPIC: Plumbing Fixtures

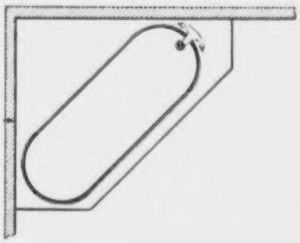
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify various types of plumbing fixtures.

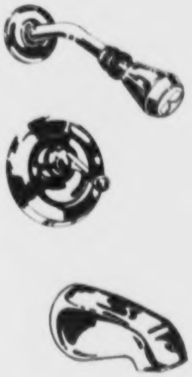
REFERENCE: Student Information Sheet/Plumbing Fixtures

DIRECTIONS: Identify each of the plumbing fixtures shown by placing the correct letter in the blank.

A. Double handle bathtub faucet
B. Water closet
C. Dish spray
D. Single handle bathtub faucet with shower
E. Corner bathtub
F. Single handle lavatory faucet
G. Ledge back lavatory
H. Single compartment kitchen sink
I. Double compartment kitchen sink
J. Double-handle with shower



1. _____



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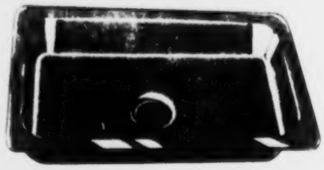

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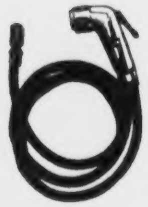

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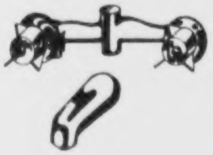

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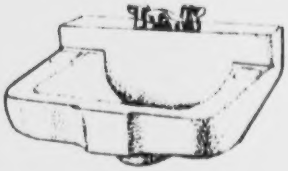

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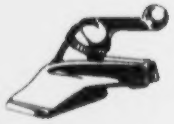

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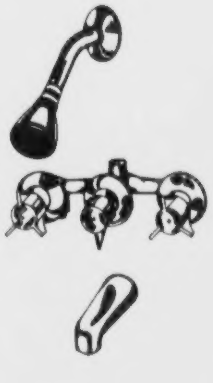

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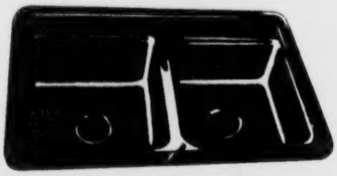

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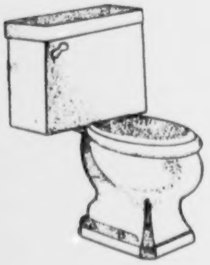


10. _____

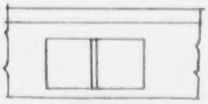
STUDENT INFORMATION SHEET

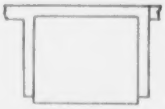
PLUMBING/PIPEFITTING

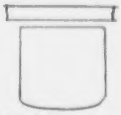
UNIT:	Fundamentals of Plumbing/Pipefitting
TOPIC:	Plumbing Symbols
UNIT OBJECTIVE:	After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of plumbing/pipefitting.
SPECIFIC OBJECTIVE(S):	After completing this information sheet, the student will be familiar with the symbols used in plumbing/pipefitting.

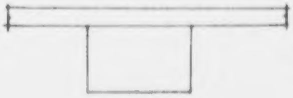
Blueprints are necessary in all phases of building trades. It is important that the plumber/pipefitter be able to read blueprints and meet specifications. Plumbing symbols are used in blueprints to identify fixtures and piping. Following is an example of these symbols. Study these symbols carefully until you become familiar with each symbol and what it represents.

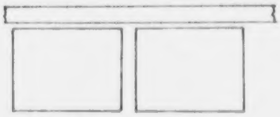
FIXTURE SYMBOLS


Kitchen sink

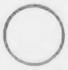

Built-in refrigerator

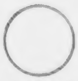

Refrigerator (free standing)

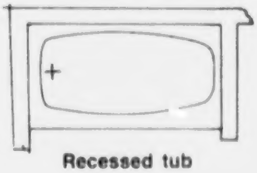

Dishwasher

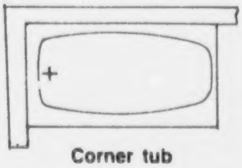

Washer Dryer

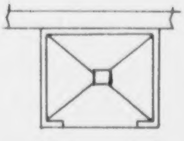
Hose bibb

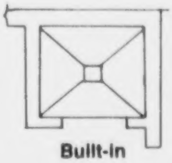

Water softener

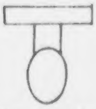

Water heater

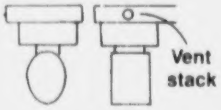

Recessed tub


Corner tub

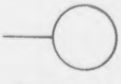

Shower stall

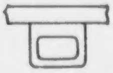

Built-in shower

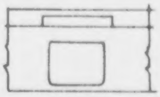

Flush valve water closet



Tank type water closets


Cesspool


Wall lavatory


Built-in lavatory

PIPING SYMBOLS

— – — – —	Cold water
—G–G—	Gas
— – – — – – —	Hot water
– – – – –	Vent
—— —— ——	Drain or waste below ground
————————	Drain or waste above ground
S-P	Sewer-plastic
S-CT	Sewer-clay tile
S-CI	Sewer-cast iron

ASSIGNMENT SHEET
PLUMBING/PIPEFITTING

NAME:______________________________ **DATE:**______________

UNIT: Fundamentals of Plumbing/Pipefitting

TOPIC: Plumbing Symbols

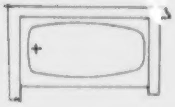
UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify plumbing symbols.

REFERENCE: Student Information Sheet/Plumbing Symbols

DIRECTIONS: Identify each of the following symbols by placing the correct letter in the blank.

A. Kitchen sink
B. Built-in refrigerator
C. Recessed tub
D. Shower stall
E. Wall lavatory
F. Tank type water closet
G. Cold water
H. Gas
I. Hot water
J. Cesspool



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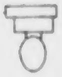

2. __

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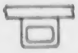

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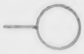

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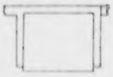

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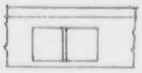

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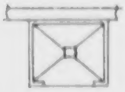
8. __



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STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT: Fundamentals of Plumbing/Pipefitting

TOPIC: Laying Out and Installing Water Supply Systems

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. explain why the plumber designs most residential water systems;
2. name and explain the factors that affect the amount of water available at each fixture;
3. explain why a uniform plumbing code is impossible; and
4. explain the terms roughing-in, topping-out, and setting fixtures.

Since most working plans for residential buildings include only the locations of the various fixtures, it is the plumber's responsibility to design the plumbing system. Generally, the specifications will state that the pipe must meet local plumbing code specifications. This means that the plumber must know the size of pipe and type of pipe that is approved for use in each local application. Although local codes regulate and are the final authority for plumbing practices, there are several general requirements that any plumbing system must meet.

General Requirements of Water Supply System

Every water system should meet these four general requirements.

1. It should be constructed of pipe and fittings that are compatible with the soil and structure served by it.
2. It should provide adequate quantities of water at each fixture.
3. It should maintain the quality of water supplied to it.
4. It should not freeze during winter months.

Use Correct Pipe

Usually, the kind of pipe used does not present a problem. By custom, plumbers are aware of the kinds of pipe suitable for the local area. For instance, copper pipe should not be used in soil that has a high concentration of sulfur. Sulfur will corrode copper pipe. Certain minerals in the water will erode galvanized pipe. Plumbers are aware of local conditions and use only the kinds of pipe compatible with these conditions.

Provide Adequate Supply of Water

Several factors affect the supply of water at each fixture. First, the water pressure at the meter affects the volume of water supplied by the system. If the pressure is low, a larger pipe size is required. Pressure ordinarily is not a factor since most municipalities provide approximately 40 to 50 pounds per square inch to homes.

Another factor is the size of pipe used. Table 1 shows the minimum pipe size normally required for each of the fixtures listed. Using pipe that is too small reduces the amount of water that can flow through the pipe. However, it increases the speed of the water to a prohibited velocity.

TABLE 1

Type of Fixture and Minimum Pipe Size Recommended

Fixture or Device	Minimum Pipe Size (inches)
Bathtub	1/2
Combination sink and tray	1/2
Drinking fountain	3/8
Dishwasher (domestic)	1/2
Kitchen sink (residential)	1/2
Kitchen sink (commercial)	3/4
Lavatory	3/8
Lavatory tray (one, two, or three compartments)	1/2
Shower (single-head)	1/2
Sinks (service, slop)	1/2
Sinks (flushing rim)	3/4
Urinal (flush tank)	1/2
Urinal (direct flush valve)	3/4
Water closet (tank type)	3/8
Water closet (flush valve type)	1
Hose bibs	1/2
Wall hydrant	1/2

The length of the pipe also affects the water supply. There is a certain amount of friction as the water flows through the pipe. The longer the pipe, the greater the friction. Water pressure drops as the amount of friction increases. The greater the volume through the tubing, the greater the velocity. In no instance is a velocity greater than 7.4 feet per second recommended.

The number and type of fittings also affect the quantity of water supplied to each fixture. Each fitting produces friction. Some types provide more friction than others. The amount of friction each produces is rated according to an equivalent length of pipe. For instance, a 3/4-inch 90 ell is equivalent to 1 foot of pipe. A 3/4-inch 90 tee run is equivalent to 1/2 foot (6 inches) of pipe, and the side out-let is equivalent to 2 inches of pipe. It is easy to see that the least possible number of fittings in a line is preferred.

Maintain Water Quality

All plumbing codes are designed to prevent direct or indirect cross-connections. All codes prohibit laying the water supply line and the sewer line in the same ditch. In fact, they cannot be laid in parallel lines within ten feet of each other.

Should Not Freeze

Underground pipe should be installed below the frost line. The frost line is the depth to which the ground normally freezes during the winter months. Pipe installed in crawlspaces should be well enough insulated to protect it against freezing.

Meeting the Requirements

Although each water supply system must meet certain requirements, the requirements are met in many different ways. For this reason, there is really no national or uniform plumbing code. Each municipality develops its own code designed to meet its own specific needs. For instance, water lines may be installed nine inches below the surface in the southern states. In the northern states, however, a water line may be required to be several feet below the surface to prevent it from freezing during the cold months.

Soil differences within a relatively small geographical area may require that different kinds of pipe be used. Certain types of soil react with copper and cause it to corrode. Copper pipe is not used in these areas. In other areas, where the pipe and soil are compatible, copper pipe is used extensively.

House construction also varies from one area to another. In one area, the pier and beam foundation is used. In another, the slab foundation is most often used. In some areas of the nation, most homes have basements. With each of these types of construction, the procedures for installing water systems differ.

Because the procedures differ, it is impossible to describe all of them. We will only explain a procedure for installing the drain, waste, and vent system and for installing the water supply system for a typical slab foundation home. While this is one acceptable design for a home, it is not the only acceptable design.

Generally, plumbing in a slab foundation house is done in three phases: (1) roughing-in, (2) topping-out, and (3) setting fixtures. Roughing-in is the process of installing subsurface pipe in its correct location before the cement foundation is poured. Since all plumbing above the floor will be hidden by the walls, exact measurements are critical. A wall will not be moved to cover misplaced plumbing. Rather, the concrete foundation must be dug out and the plumbing moved so that it will be located inside the wall.

Topping-out is the process of installing the pipe that will be hidden by the walls. It is done after the house has been framed but before the wall covering has been installed. The pipe is stubbed out at the location for each fixture so that the fixture can be installed after the wall covering has been installed. Setting fixtures is just what the term says. It is the actual setting of the fixtures in their proper locations.

Water Supply Rough-in

Rough-in is done after the foundation forms have been set but before the cement has been poured. The forms have been set. The backfill has been put in place and leveled. At this point, the plumber must install all of the pipe that will be located beneath the foundation when it is poured. The end of the pipe to each fixture will be set so that it will protrude above the level of the cement when it is poured.

ASSIGNMENT SHEET

PLUMBING/PIPEFITTING

NAME: ____________________ **DATE:** __________

UNIT: Fundamentals of Plumbing/Pipefitting

TOPIC: Laying Out and Installing Water Supply Systems

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of Plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. explain why the plumber designs most residential water systems;
2. name and explain the factors that affect the amount of water available at each fixture;
3. explain why a uniform plumbing code is impossible; and
4. explain the terms roughing-in, topping-out, and setting fixtures.

REFERENCE: Student Information Sheet/Laying Out and Installing Water Supply Systems

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. Why must the plumber design most plumbing systems for residential buildings?

2. Why is it important that the plumber know the local plumbing codes.

3. What are four general requirements any water supply system must meet?

4. Why is the kind of pipe to use not usually a problem?

5. Why is water pressure usually not a factor in providing adequate water supply?

6. How does the use of pipe that is too small affect the water supply?

7. Why does the length of the pipe affect the water supply?

8. What is the maximum number of feet per second recommended for flow velocity?

9. Why does the number of fittings affect the flow of water?

10. Why do city plumbing codes prohibit laying DWV and potable water lines in the same trench?

11. Why can there be no uniform plumbing code across the United States?

12. What is included in the process of roughing-in?

13. What is included in the process of topping-out?

14. What is included in the process of setting fixtures?

15. What is the condition of the house when the rough-in is done?

STUDENT INFORMATION SHEET

PLUMBING/PIPEFITTING

UNIT: Fundamentals of Plumbing/Pipefitting

TOPIC: Laying Out and Installing Drain, Waste, and Vent Systems

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): After completing this information sheet, the student will be able to:

1. explain the functions of the DWV system;
2. explain why the DWV system is laid before the water supply system;
3. explain why the DWV system is laid at a grade between 1/4-inch and 1/8-inch fall;
4. explain why the size of the DWV pipe is important; and
5. explain why the DWV system must be vented.

A drain, waste, and vent (DWV) system must meet certain requirements. It must provide adequate drainage for each fixture. It must trap odorous and poisonous gases so that they do not escape from the sewer system into the house. It must vent the system to allow the water to flow freely. It must also prevent siphonage that would drain the traps. It is the plumber's responsibility to design a system that meets these requirements.

The DWV system is designed before the water supply system for two important reasons. First, it must be laid in straight lines. It is important that it be laid out using the fewest materials possible. It is better to work the water supply system around the requirements of the DWV system than the other way around.

Most plumbing codes provide that sewer lines be made of certain materials and conform to certain specifications. The codes establish the size and conditions under which different pipe may be used.

Sewer and water supply lines must be installed in separate trenches. Each system must be installed at a minimum depth, according to local needs.

The sewer line must be installed at a uniform grade. For instance, some city codes require that drainage pipe 3 inches or smaller must have a fall of not less than 1/4 inch per foot. Drainage pipe larger than 3 inches must have a fall of not less than 1/8 inch per foot. In cases where conditions do not permit drainage to be laid at these specifications, provisions may require that a fall provide a minimum of 2 feet per second.

DWV systems operate by gravity. The drain fall or slope should be such that the water will carry the solids with it. If the fall is too great, the water will flow past the solids, allowing the pipe to stop up. If the fall is too shallow, there is no flow, which also creates a stoppage. The correct fall is between 1/4 and 1/8 inch per foot. This permits the greatest scouring action by the water as it flows.

The fall must be uniform in order to prevent situations that create air bubbles that will prevent water from flowing through the pipe. Figure 1 shows a buckle in the sewer line. An air bubble is caused by the pipe buckling up. If the rise in the buckle is greater than the inside diameter of the pipe, an air bubble is formed. All plumbing codes require that the trenches have a suitable bed on which to lay the sewer pipe. If the natural soil is not suitable, gravel or concrete pads may be required to provide the stability.

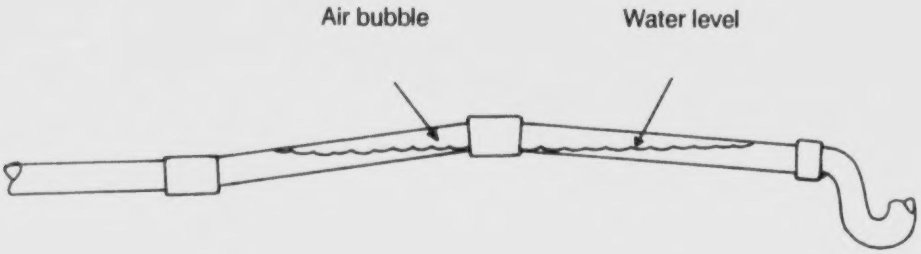


Figure 1. A buckle greater than the diameter of the pipe causes an air bubble.

If the fall is too great, a principle called the hydraulic gradient can siphon water from a trap. If a fixture drain has a fall greater than the diameter of the drain pipe between the drain opening and the trap, the drain will have a tendency to siphon the water from the trap.

Each type of fixture is given a fixture unit value. A fixture unit value is the load factor given for a particular fixture in determining the diameter of pipe required to handle a drainage system.

Pipe size is important in providing an adequate drainage system. Pipe size determines the depth of the water flowing through it. The size for a given system is calculated to provide sufficient depth to produce good scouring action, without overloading the pipe during peak usage.

Just as the drainage pipe is determined by the number of fixture units, so are the sizes of the vent pipes.

Venting the DWV system is required for two reasons. First, the vent equalizes the atmospheric pressure inside the drain pipe and on the surface area of the water in the fixture being drained. If it were not equalized, the atmospheric pressure on the water surface of the fixture being drained would push the water through the trap (siphonage). Figure 2A illustrates a fixture with no vent. The weight of the water falling through the drain pipe breaks the atmospheric pressure inside the pipe. This allows the atmospheric pressure to force the water through the trap. Figure 2B illustrates a fixture with a vent to the outside atmosphere. Atmospheric pressure is equal on both sides of the trap. This allows gravity to hold water in the trap, making a seal.

A second reason for venting is to prevent pressure from building up and blowing water out of a trap between the fixture being drained and the sewer line. As water flows from a fixture into the drain pipe, the air in front of it must be able to move also. If it does not have a vent to flow out of, the water flow slows until pressure builds up enough to force the air out the nearest trap. It will blow the water out of the trap as it escapes. As the water flows by the blown trap, the remaining water in the trap will be siphoned from it. In the meantime, the drains are balky, never functioning properly.

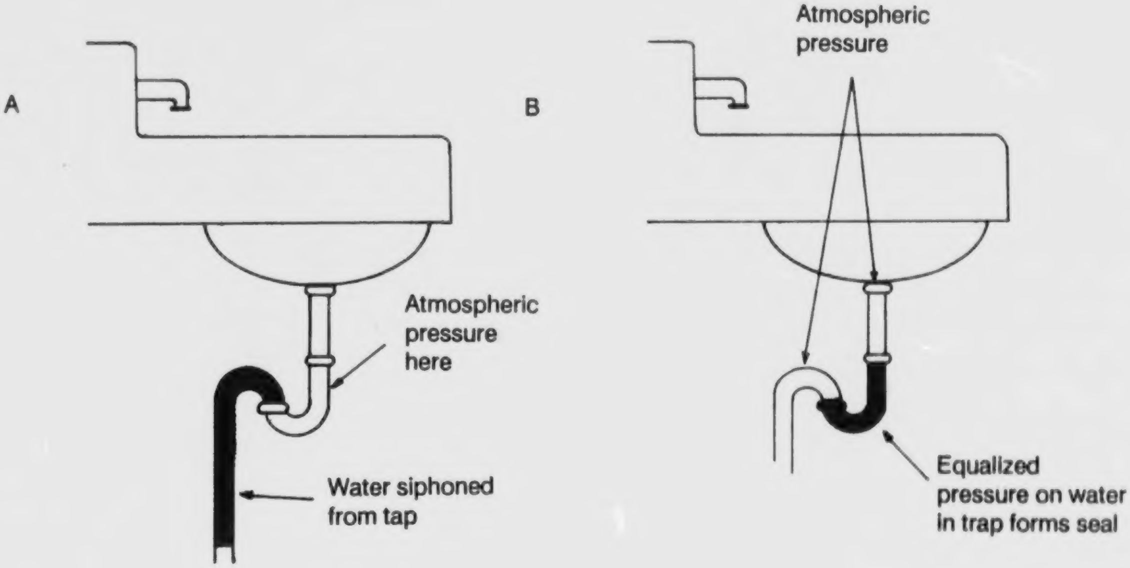

A
Atmospheric pressure here
Water siphoned from tap
B
Atmospheric pressure
Equalized pressure on water in trap forms seal

Figure 2A: Weight of water breaks atmospheric pressure and siphons trap; B: Atmospheric pressure is equalized on both sides of trap. Water forms seal in trap.

ASSIGNMENT SHEET
PLUMBING/PIPEFITTING

NAME: ______________________________ **DATE:** ______________

UNIT: Fundamentals of Plumbing/Pipefitting

TOPIC: Laying Out and Installing Drain, Waste, and Vent Systems

UNIT OBJECTIVE: After completion of this unit, the student will be able to demonstrate an understanding of the fundamentals of plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will:

1. explain the functions of the DWV system systems;
2. explain why the DWV system is laid before the water supply system;
3. explain why the DWV system must be laid at a grade between 1/4-inch and 1/8-inch fall;
4. explain why the size of the DWV pipe is important; and
5. explain why the DWV system must be vented.

REFERENCE: Student Information Sheet/Laying Out and Installing Drain, Waste, and Vent Systems

DIRECTIONS: Read and answer each of the following questions in the space provided.

1. What requirements must a DWV system meet?

2. List two reasons why the DWV system is laid before the water supply system.

3. How much fall must sewer pipe have?

4. What happens if a sewer has too much fall?

5. What happens if the fall is too little?

6. How far may a drain pipe buckle upwards?

7. What is used to support drain pipe if the soil is unsuitable for the purpose?

8. What happens if the fall between the drain opening and a trap is greater than the diameter of the drain pipe?

9. Why is pipe size important in a drainage system?

10. Why is the depth of the water flowing through a pipe important?

11. List two reasons why a DWV system must be vented.

12. What happens if the atmospheric pressure is not equalized?

13. What happens if pressure is allowed to build up in the drain pipe?

JOB SHEET

PLUMBING/PIPEFITTING

NAME: ____________________ **DATE:** ____________

UNIT: Working in Plumbing/Pipefitting

NAME OF JOB: Bending Copper Tubing

UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will bend pipe according to instructions.

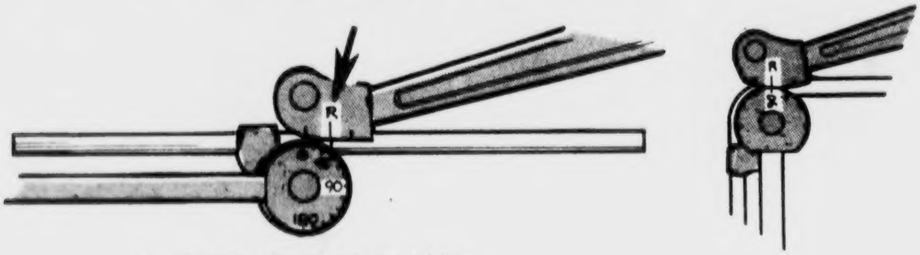
TOOLS AND EQUIPMENT: Tubing cutter, 3/8-inch level type tubing bender

MATERIALS: Twelve inches 3/8-inch O.D. (outside diameter) copper tubing

GENERAL INSTRUCTIONS: When bending copper tubing, you must use care not to make a sharp bend in the tubing. The bend must be smooth so that the tubing will not be weak or develop a leak.

PROCEDURES AND/OR TASK:

1. Measure six inches from one end of tubing and make a mark.
2. Put tubing in bender so "R" mark is even with the mark on the tubing.
3. Pull lever until "R" mark is even with 90° mark.



4. Remove bender from tubing.
5. Have instructor check your work.
6. Store tools properly.
7. Wash your hands.

JOB SHEET

PLUMBING/PIPEFITTING

NAME: ______________________________ **DATE:** ______________

UNIT: Working in Plumbing/Pipefitting

NAME OF JOB: Sweating a Joint

UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will sweat a joint.

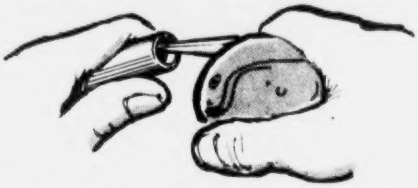
TOOLS AND EQUIPMENT: Tubing cutter with reamer, propane torch, safety glasses, soldering block

MATERIALS: 3/8-inch copper tubing, 3/8-inch copper sweat fitting, fine sandpaper, solder, solder flux

GENERAL INSTRUCTIONS: Soldering (sweating) is a method of joining base metals by using a nonferrous filler metal. The filler metal is heated to a melting point that is below 800° F. Actually, most soldering is done at temperatures below 500° F, but 800° F is the temperature that separates soldering and brazing.

PROCEDURES AND/OR TASKS:

1. Cut tubing to length with tubing cutter.
2. Remove burr from inside of tubing with reamer on tubing cutter.



3. Sand outside of tubing at end to be soldered.
4. Wipe with clean cloth.

   (**NOTE:** Do not touch cleaned area since body moisture will cause surface to oxidize.)

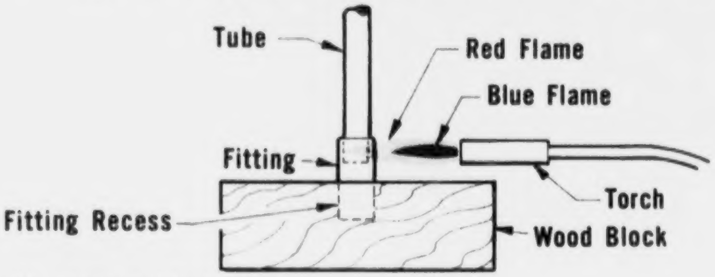
5. Apply a thin film of flux to cleaned end of tubing.

   (**NOTE:** Use the brush on the lid of the flux can.)

6. Insert tubing into fitting.

   (**NOTE:** Twist the tubing while inserting into fitting to spread flux evenly.)

7. Wipe off excess flux with the clean cloth.
8. Place fitting in soldering block.
9. Put on safety glasses.
10. Light torch and adjust flame.
11. Apply heat to entire joint, holding blue flame about 1/8 inch from joint.



12. Apply solder to joint.

    (**NOTE:** Do not allow flame to melt solder. When joint has been heated to proper temperature, solder will melt and flow into fitting joint. If solder does not melt on contact with fitting, reheat joint.)

13. Remove heat when solder flows from joint.
14. Turn off torch and allow solder to cool.
15. Have instructor check your work.
16. Clean and store tools properly.
17. Wash your hands.

JOB SHEET

PLUMBING/PIPEFITTING

NAME: ______________________________ **DATE:** ______________

UNIT: Working in Plumbing/Pipefitting

NAME OF JOB: Cutting Steel Pipe

UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipe-fitting.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will cut steel pipe according to instructions.

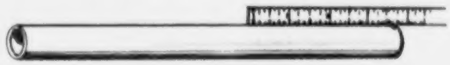
TOOLS AND EQUIPMENT: Pipe vise, hacksaw, folding ruler, pipe cutter, reamer

MATERIALS: Length of steel pipe (1/2 or 3/4-inch diameter)

GENERAL INSTRUCTIONS: Steel pipe is available in many different lengths. However, it is often necessary for the plumber/pipefitter to cut the pipe to the desired length for a specific job. This can be accomplished using the following steps.

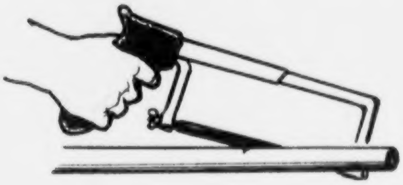
PROCEDURES AND/OR TASKS:

1. Measure length to be cut with folding ruler.



2. Mark the pipe using the hacksaw.

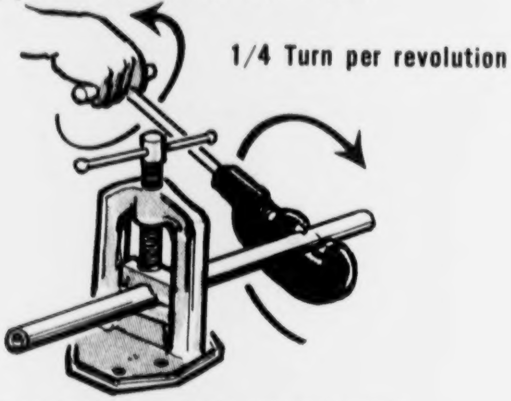
   (**NOTE:** When marking only, pull the hacksaw across the pipe rather than push.)



3. Fasten the pipe in the vise with mark at least four inches from vise.
4. Place pipe cutter on pipe.

5. Tighten cutter on pipe until cutting wheel is snug on pipe.

6. Rotate pipe cutter in direction shown below.

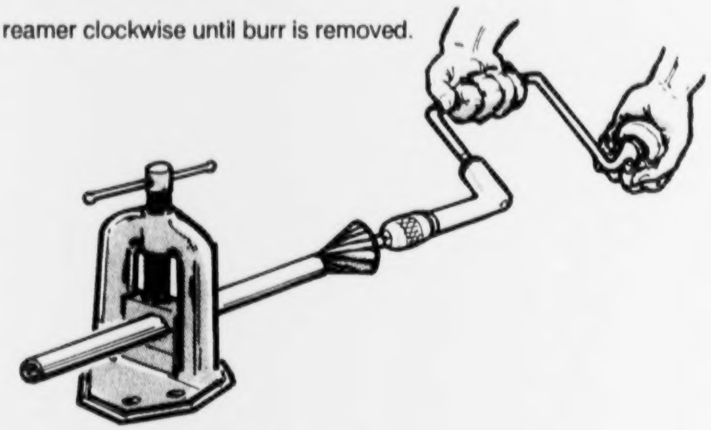


7. After each rotation, turn cutter handle 1/4 turn.

8. Repeat step seven until pipe is cut to length.

9. Place reamer in end of pipe.

10. Turn reamer clockwise until burr is removed.



11. Check to be sure all burrs are removed.

12. Clean and store tools properly.

13. Wash your hands.

JOB SHEET

PLUMBING/PIPEFITTING

NAME:____ **DATE:**____________

UNIT: Working in Plumbing/Pipefitting

NAME OF JOB: Threading Steel Pipe

UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will thread a steel pipe according to instructions.

TOOLS AND EQUIPMENT: Pipe vise, file, correct size pipe threader, wire brush

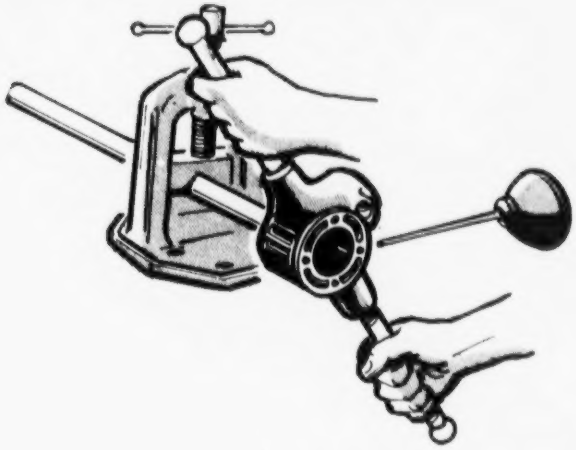
MATERIALS: Cutting oil, pipe prepared in job sheet "Cutting Steel Pipe"

GENERAL INSTRUCTIONS: When it is necessary for a plumber/pipefitter to cut a steel pipe, it will also be necessary to thread the end of the pipe in order to join it. Threading may be done by following these procedures.

PROCEDURES AND/OR TASKS:

1. Place pipe in vise.
2. Remove burrs on outside of pipe using the file.
3. Place threader on pipe.

   (**NOTE:** Be sure threader is flat against end of pipe.)
4. Keep dripping oil on area to be threaded.



5. Continue threading until one thread is out of threader.
6. Screw off threader and inspect the threads.
7. Clean threads with the wire brush.
8. Clean and store tools properly.
9. Wash your hands.

JOB SHEET

PLUMBING/PIPEFITTING

NAME:____ **DATE:**_______________

UNIT: Working in Plumbing/Pipefitting

NAME OF JOB: Joining Pipe

UNIT OBJECTIVE: After completion of this unit, the student will demonstrate the ability to perform basic job skills in plumbing/pipefitting.

SPECIFIC OBJECTIVE(S): In completing this job sheet, the student will join piping by at least one other method (glue, couple, weld, etc.).

TOOLS AND EQUIPMENT: Two pipe wrenches (rated for the size of pipe being used)

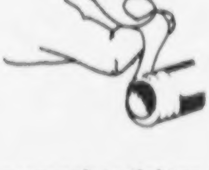
MATERIALS: Length of pipe from job sheet "Threading Steel Pipe," one 90° elbow of the same size, joint compound or Teflon tape, cloth

GENERAL INSTRUCTIONS: Clean both length of pipe and elbow with clean cloth. Join pipe to elbow following these procedures.

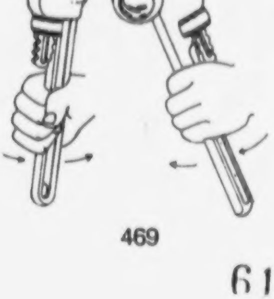
PROCEDURES AND/OR TASKS:

1. Coat the male threads (outside threads) with either Teflon tape or joint compound.

   (**NOTE:** Do not apply to female threads.)



2. Use one pipe wrench to tighten the elbow.
3. Use the second pipe wrench as a backup.



PLUMBING

4. Clean and store tools properly.

5. Wash your hands.

SECTION VII

COMMON ESSENTIAL ELEMENTS

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Leadership

TOPIC: Leadership Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of leadership concepts and skills.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to identify terms and definitions associated with leadership.

Below is a list of terms and definitions. Study these terms until you are comfortable in discussing what each one means.

1. **Autocratic**--having a complete power; an autocratic person forces others to do what he-she wishes.
2. **Communicate**--to get information across so that it is understood by another person.
3. **Democracy**--the practice of allowing equal participation by all members of society.
4. **Dependable**--reliable; can be counted on.
5. **Initiative**--the ability to get things done without needing to be told to do so.
6. **Leadership**--the ability to inspire confidence and loyalty so that others follow willingly in order to achieve a desired goal.
7. **Maturity**--the condition of being fully grown.
8. **Motivation**--a desire that makes you do something.
9. **Optimistic**--belief that there is more good than bad.
10. **Strength of conviction**--to make a logical decision and stick by it, even if the majority do not agree with you.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________ **DATE:** ______________________

UNIT: Leadership

TOPIC: Leadership Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of leadership concepts and skills.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify terms and definitions associated with leadership.

REFERENCE: Student Information Sheet/Leadership Terms and Definitions

DIRECTIONS: Unscramble the following words:

1. A desire that makes you do something

   niottomavi ______________________

2. To get information across so that it is understood by another person

   mmocnuetaci ______________________

3. Belief that there is more good than bad

   pomiiittcs ______________________

4. Having the power; this person forces others to do what he/she wishes

   aatourctic ______________________

5. The ability to inspire confidence and loyalty so that others follow willingly in order to achieve a desired goal

   eeadlpihsr ______________________

6. Reliable; can be counted on

   peenddleba ______________________

7. The condition of being fully grown

   aitmruyt ______________________

8. The ability to get things done without needing to be told to do so

   iiittaveni ______________________

9. To make a logical decision and stick with it, even if the majority do not agree with you

gsnetrht fo vnoioincct ______________________________

10. The practice of allowing equal participation by all members of society

cryomeacd ______________________________

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT:	Leadership
TOPIC:	Parliamentary Procedure
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of leadership concepts and skills.
SPECIFIC OBJECTIVE(S):	After completion of this information sheet, the student will be able to demonstrate an understanding of parliamentary procedure.

Have you ever stopped to think about how meetings are conducted? How do those involved know what to say or when to say it? You may not be aware of it, but most meetings follow a set of rules called parliamentary procedure.

Following is an outline of information about parliamentary procedure based on Roberts Rules of Order Revised.

I. Order of Business (May vary to suit organization)
   A. Call to order or invocation
   B. Roll call--to determine if quorum is present
   C. Reading and approving minutes (general consent)
   D. Treasurer's report (placed on file)
   E. Reports of other officers (correspondence included here)
   F. Reports of executive board of committees
   G. Reports of special committees
   H. Unfinished business--anything previously before the body
   I. New business
   J. Announcements

II. Eight Essential Steps Are Followed in Obtaining Action of the House:
   A. Members
      1. Rise, address the Chair
      2. Await recognition

3. Make the motion, "I move that . . ."

4. Second the motion, "I second the motion."

B. Chair

5. States the motion, "It has been moved and seconded that . . . "

6. Calls for remarks if motion is debatable.

7. Takes the vote (called "putting the question").

8. States the result.

III. Minutes Must Have the Following Items

A. The kind of meeting (regular, special, called, etc.)

B. Name of the assembly

C. Date, time, and place of meeting

D. Fact of presence of regular chairman and secretary or substitutes, and quorum

E. Whether the minutes of the previous meeting were approved

F. All the main motions and disposition of them; points of order appeal

G. The time of meeting, adjournment, and name of recorder

H. Signature of Secretary. Word "Approved" and date of approval should be noted on the bottom of minutes by secretary. Names of those making motions should be entered, but seconder's name need not be recorded. Minutes are a record of what is "done" and not what is said.

IV. Seven Important Points About A Motion

A. Its object or use

B. Does it require a second?

C. Is it debatable?

D. Is it amendable?

E. To what motions does it yield?

F. What vote is required to carry it?

G. May it be reconsidered?

ESSENTIALS OF A GOOD MEETING

1. Be carefully planned in advance.
2. Be started and closed on time.
3. Move along with pep and enthusiasm, so members will not become bored and time will not be wasted.
4. Proceed according to the order of business.
5. Be conducted according to parliamentary procedure.
6. Include use of official opening and closing ceremonies.
7. Display chapter banner and officer banners.
8. Be held in a well-lighted, ventilated, comfortable meeting place.
9. Include well-prepared committee reports.
10. Demonstrate officers' knowledge of duties and responsibilities.
11. Hold the interest and attention of all members.
12. Provide an opportunity for member participation.
13. Teach members to work together.
14. Include both business and entertainment.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME:______________________________ **DATE:**______________________

UNIT: Leadership

TOPIC: Planning and Conducting a Meeting

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of leadership concepts and skills.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate the ability to plan and conduct a meeting.

REFERENCE: Student Information Sheet/Parliamentary Procedure

DIRECTIONS: This is a group activity in which each class member will take part. Following procedures from Roberts Rules of Order Revised, have the students elect class officers to serve for one semester. Establish committees to meet the needs of the class. Each student will be assigned to serve on at least one committee.

Class meetings should be held as time permits following the Parliamentary Procedures given on Information Sheet.

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Employment

TOPIC: Employment Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to identify terms and definitions associated with employment and/or postsecondary training.

Below is a list of terms and definitions. Study these terms until you are comfortable in discussing what each one means.

1. **Accurate**--free from mistakes; a truthful account. Is this an accurate record of your past employment?
2. **Address**--the place where your receive your mail. Permanent address is the place where you may always receive your mail, such as your parents' address, while present address is the place you receive your mail now. What is your present address?
3. **Applicant**--one who applies fo a job. Are you one of the top applicants?
4. **Bondable**--usually refers to the right to be insured. People who handle large sums of money are sometimes asked to be insured against theft or embezzlement. If offered this job, would you be bondable?
5. **Character**--usually refers to such personality traits as honesty, dependability, loyalty, etc. Could you name three character references? (This means could you name three people who could verify your personality traits?)
6. **Chronic**--keeps coming up; recurring; usually relates to an illness, such as diabetes or epilepsy, which requires medication. Do you have any chronic illness?
7. **Compensation**--payments; usually refers to payment due to an injury on the job (worker's compensation) or payment due to being out of a job (unemployment compensation). Have you collected worker's compensation in the last two years?
8. **Confidential**--refers to being kept a secret or private. You can be sure that the information concerning your past employment will be confidential.
9. **Convicted**--to be proved guilty by a judge or jury of a crime. Have you ever been convicted of a felony?
10. **Dependents**--persons who rely upon you for support; usually refers to the number of children you have. How many dependents do you have?

11. **Disability**--usually refers to not being able to work because of an injury; insurance may be taken out which will provide a check if you are unable to work. The insurance is paid either by the employee or the employer. Have you claimed any disability insurance in the last year?

12. **Eligible**--able or worthy of being chosen. Are you eligible for employment at this time?

13. **Emergency**--an unexpected act causing a need for some type of action right away. Who should be notified in case of an emergency?

14. **Employer**--the person or business for whom a person works. Who was your previous employer?

15. **Excluding**--to leave out; not include. How many jobs have you held, excluding your present job?

16. **Fee**--a set amount of money you must pay for certain services. Would you be willing to pay a small fee for our services?

17. **Felony**--a federal crime for which punishment may be death or imprisonment for more than one year. Have you ever been convicted of a felony?

18. **Institution**--a place where you may receive formal training or education. What is the name of the institution from which you received your diploma?

19. **Insurance**--coverage against a loss; usually refers to health/life insurance, unemployment insurance, and disability insurance. Have you collected unemployment insurance in the last year?

20. **Legibly**--written in a way which can be read. Your application should be typed or written legibly.

21. **Maiden name**--the last name of a woman before she is married. What is your maiden name?

22. **Marital status**--refers to being single, married, separated, or divorced. What is your marital status?

23. **Misdemeanor**--a crime less serious than a felony. Have you ever been convicted of a misdemeanor?

24. **Misrepresented**--to give a false or misleading statement; usually appears at the end of a job application before the signature. I certify that the above statements are true, and in no way is any information misrepresented.

25. **Naturalized**--to become a citizen. On what date were you naturalized?

26. **Not applicable**--does not apply to you; usually expressed as N/A. If the information does not apply to you, please write N/A.

27. **Omission**--the state of being left out or blank; usually as an error. If you do not write the term N/A in a blank, the employer will think it was an omission on your part.

28. **Optional**--having a choice. Listing your age on the application is optional.

29. **Personal**--belonging to you; usually refers to information about your height, weight, marital status, age, etc. Please include all personal data on the first page.

30. **Personnel**--a group of persons belonging to an organization. A personnel director is usually in charge of hirings, firings, disagreements, etc. The personnel in this business are young, energetic individuals.

31. **Probationary**--a period of time during which a company sees if you can do the job you were hired for. You realize that there is a probationary period of six months.

32. **Qualified**--having the skill, training, and/or education to do a job. Why do you feel you are qualified?

33. **Reference**--someone who can be asked to file an answer to questions about a person's ability to do a job; usually there are two types of reference: past employers and character references. Please name three references.

34. **Relatives**--people who are related to you. Do you have any relatives working here?

35. **Reverse side**--on the other side. Please include any additional information on the reverse side.

36. **Salary**--usually refers to a fixed amount of pay not directly related to the number of hours you work. What is the beginning salary?

37. **Sex**--refers to being male or female. To what sex do you belong?

38. **Signature**--a person's name, written in longhand. Please read the application and include your signature at the bottom.

39. **Spouse**--depending on your sex, your husband or wife. What is your spouse's occupation?

40. **Wage**--usually refers to the amount of money you earn during an hour. What is the minimum wage?

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME:______________________________ **DATE:**______________________

UNIT: Employment

TOPIC: Employment Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify terms and definitions associated with employment and/or postsecondary training.

REFERENCE: Student Information Sheet/Employment Terms and Definitions

DIRECTIONS:

1. Make a copy of Student Information Sheet/Terms and Definitions.
2. Cut out each item along the lines.
3. Place the slips of paper in either a hat or box for drawing purposes.
4. Divide the class into two groups. They should stand on opposite sides of the room.
5. Each group should invent a clever name. Write the names of the groups on the board.
6. Each student will draw a slip of paper and immediately give it to the teacher.
7. The teacher will say the word that appears on the slip. The student will then define the word and use the word in a sentence to the satisfaction of the teacher. A mark is placed by the group's name each time a student defines the word correctly.
8. The other group will follow steps six and seven.
9. When all words have been used, the group with the most marks will be declared the winner.

COPIES OF THIS ACTIVITY COULD BE MADE FOR ALL STUDENTS TO EASE ANY MISUNDERSTANDINGS. HOWEVER, THE TEACHER MAY WANT TO READ THE DIRECTIONS TO THE CLASS.

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Entrepreneurship

TOPIC: Entrepreneurship Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to identify terms and definitions associated with entrepreneurship.

Below is a list of terms and definitions. Study these terms until you are comfortable in discussing what each one means.

1. **Achievement**--something achieved by skill, work, courage, etc.

2. **Capital**--money or property, especially when used in business to make more money.

3. **Capitalism**--economic and political system in which people privately own goods and investments and where the production, distribution, and sale of goods is based on competition in a free market.

   (**NOTE**: Capitalism is interchangeable with the term free enterprise.)

4. **Capital resources**--the basic "tools" used to change raw materials into goods and services.

5. **Communism**--economic and political system in which the government owns and controls all private and state means of production and distributes economic goods among the people as needed; no private or state ownership exists in a communistic society.

6. **Courage**--the quality of being able to control one's fear; bravery.

7. **Creativity**--ability to create, having imagination and ability.

8. **Curiosity**--a strong feeling of wanting to know or learn.

9. **Demand**--amount of goods and services a customer will want to buy.

10. **Entrepreneurship**--the organizing, managing, and operating of a small business by an individual.

11. **Free enterprise**--the right to start and manage a business, compete with other businesses, and seek a profit, providing it is not forbidden by law.

12. **Independence**--freedom from the control of others.

13. **Inventory**--a complete list of goods or property; the stock of goods on hand.

14. **Labor force**--all people 16 years or older employed as civilians laboring more than 15 hours a week for wages; also those workers who are unemployed and the armed forces.

15. **Licenses**--a paper, card, etc. showing that one is permitted by law to do something.
16. **Partnership**--a business firm made up of two or more partners.
17. **Permit**--a paper, card, etc. showing permission.
18. **Personality traits**--all the special qualities which make a person different from other people.
19. **Profit**--money remaining after all costs of operating a business are paid.
20. **Regulation**--a rule or law that regulates.
21. **Self-confidence**--sure of oneself, confident of one's own ability.
22. **Socialism**--economic and political system in which there is collective government ownership and control of most means of production and distribution of goods.
23. **Supply**--amount of goods and services that will be offered for sale.
24. **Technology**--applying service for the practical purpose of producing more and better goods and service for industrial uses.
25. **Wages**--usually refers to the amount of money you earn during an hour.
26. **Zoning**--a section of a city set apart by law for a particular use, as for homes or for business.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________________ **DATE:** ____________________

UNIT: Entrepreneurship

TOPIC: Entrepreneurship Terms and Definitions

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify terms and definitions associated with entrepreneurship.

REFERENCE: Student Information Sheet/Entrepreneurship Terms and Definitions

DIRECTIONS: Find the words that best fit the descriptions at the bottom of this page. Circle your answers.

X	K	L	O	R	U	S	M	U	B	D	C	T	Q	R	T	O	N	M	V
R	M	B	X	S	N	I	V	S	O	C	I	A	L	I	S	M	B	U	S
M	C	D	M	B	R	S	L	K	G	A	B	D	E	N	S	O	V	N	O
N	A	E	N	S	L	K	G	H	V	I	N	G	R	I	E	D	S	L	N
L	P	B	D	P	R	O	F	I	T	A	G	B	N	K	G	A	Y	U	P
P	I	G	L	K	N	S	T	M	O	L	G	U	O	F	X	G	O	L	M
R	T	B	C	D	K	L	N	G	B	V	M	T	S	G	O	T	V	U	R
Z	A	E	A	C	D	B	E	L	G	M	K	B	D	L	Y	R	O	X	L
M	L	B	G	H	L	M	C	K	O	R	T	Z	O	N	L	V	C	O	V
V	I	E	G	A	G	B	L	C	F	G	I	N	M	K	H	I	G	E	S
O	S	U	P	P	L	Y	A	B	A	I	H	O	H	B	K	C	B	L	N
P	M	V	L	R	T	S	R	N	G	C	L	K	M	C	G	M	D	K	C
K	G	M	K	B	D	E	T	E	E	A	G	P	I	G	A	L	E	M	A
H	S	R	M	L	V	K	L	T	L	K	R	E	S	O	U	R	C	E	S
G	Z	N	T	X	U	R	V	K	E	L	D	A	G	K	O	L	S	O	B
I	B	D	E	H	R	X	N	I	O	M	E	C	M	T	S	R	T	R	D
O	A	D	E	M	A	N	D	G	N	G	H	B	S	V	L	M	V	T	R
R	N	S	R	V	Z	Y	A	C	D	K	M	O	Z	T	U	C	D	E	A
V	X	Z	O	L	U	E	B	E	N	T	E	R	P	R	I	S	E	B	K
T	S	V	U	W	L	K	G	L	K	S	A	S	I	U	D	E	S	L	M

1. Economic and political system in which the people privately own goods and investments and where the production, distribution, and sale of goods is based on competition in a free market.

2. All people 16 years or older employed as civilians laboring more than 15 hours a week for wages and those workers who are unemployed and the armed forces make up the labor ______________________.

3. Capital ______________________ are the basic "tools" used to change raw materials into goods and services.

4. Amount of goods and services a customer will want to buy.

5. Free ______________________ is the right to start and manage a business, compete with other businesses, and seek a profit, providing it is not forbidden by law.

6. Applying service for the practical purpose of producing more and better goods and services for industrial uses.

7. Amount of goods and services that will be offered for sale.

8. Money remaining after all costs of operating a business are paid.

9. Economic and political system in which the government owns and controls all private and state means of production and distributes economic goods among the people as needed; no private or state ownership exists in a communistic society.

10. Economic and political system in which there is collective or government ownership and control of most means of production and distribution of goods.

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Entrepreneurship

TOPIC: What Is Entrepreneurship?

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to demonstrate an understanding of entrepreneurship.

What Is an Entrepreneur?

Entrepreneurship is the organizing, managing, and operating of a small business. Not everyone is suited to being an entrepreneur. Individuals whose personality traits involve need for achievement, need for independence, self-confidence, high level of activity, courage, curiosity, and creativity may choose to become entrepreneurs.

Why Should You Start a Company?

There are many different reasons for starting your own business. Entrepreneurship may be a way for you to make more money than you could if you worked for someone else. It also provides you with a chance to do something different. As an entrepreneur you can use your own ideas. You may also be recognized as a professional. Finally, you may just like being your own boss.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME:____________________ **DATE:**____________________

UNIT: Entrepreneurship

TOPIC: Am I an Entrepreneur?

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of what it takes to be an entrepreneur.

REFERENCE: Student Information Sheet/What Is Entrepreneurship?

DIRECTIONS: Under each question, check the answer that says what you feel or comes closest to the way you feel. Be honest with yourself.

Are you a self-starter?

____ I do things on my own. Nobody has to tell me to get going.

____ If someone gets me started, I keep going all right.

____ Easy does it. I don't put myself out until I have to.

How do you feel about other people?

____ I like people. I can get along with just about anybody.

____ I have plenty of friends--I don't need anyone else.

____ Most people bother me.

Can you lead others?

____ I can get most people to go along when I start something.

____ I can give orders if someone tells me what we should do.

____ I let someone else get things moving. Then I go along if I feel like it.

Can you take responsibility?

____ I like to take charge of things and see them through.

____ I'll take over if I have to, but I'd rather someone else be responsible.

____ There's always some eager beaver around waiting to show how smart he/she is. I say, "Let 'em."

How good an organizer are you?

____ I like to have a plan before I start. I'm usually the one to get things lined up when friends want to do something.

____ I do all right unless things get fouled up. Then I disappear.

____ You get ready and then something comes along and stops the plan. So, I just take things as they come.

How good a worker are you?

____ I can keep going as long as I am needed. I don't mind working for something I want.

____ I'll work hard for a while, but when I've had enough, that's it!

____ I can't see that hard work gets you anywhere.

Can you make decisions?

____ I can make up my mind in a hurry if necessary. It usually turns out O.K., too.

____ I can, if I have plenty of time. If I have to make up my mind fast, I think later that I should have decided the other way.

____ I don't like to be the one who has to decide things. I'd probably ruin it.

Can people trust what you say?

____ Yes, they can. I don't say things I don't mean.

____ I try to be honest most of the time, but sometimes I just want what is easiest.

____ What does it matter if the other person doesn't know the difference?

Can you stick with it?

____ If I make up my mind to do something, I don't let anything stop me.

____ I usually finish what I start--if it doesn't get fouled up.

____ If it doesn't go well right away, I stop. Why beat your brains out?

How good is your health?

____ I never run down!

____ I have enough energy for most things I want to do.

____ I run out of energy sooner than most of my friends seem to.

Now count the checks you made.

____ How many checks are beside the first answer to each question?

____ How many checks are beside the second answer to each question?

____ How many checks are beside the third answer to each question?

If most of your checks are beside the first answer, you probably have what it takes to run a business. If not, you're likely to have more trouble than you can handle by yourself. Better find a partner who is strong on the points you are weak on. If many checks are beside the third answer, not even a good partner could make your business a success.

Source: The High School Student in the Working World. A Handbook for Counselors. Texas Education Agency, Austin, Texas, July, 1981.

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT:	Entrepreneurship
TOPIC:	Getting Started
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.
SPECIFIC OBJECTIVE(S):	After completion of this information sheet, the student will be able to demonstrate an understanding of how to start a business.

What Do You Need to Know?

What types of information would you need to start a business? There are general areas you should know about. Prior to starting a business, you should learn all you can about that specific type of business. Talk with an accountant or financial advisor in order to determine how much money or capital you will need to get started. Be aware that a good business location is of primary importance. There are questions you should ask yourself. How will you manage your inventory? What will your credit policy be? How much money can you afford to take out of the business? How could your business be expanded? Careful consideration should be given to all aspects.

Steps in Starting a Business

There are steps you should take in starting a new business. Establish a checking account with a commercial bank. It may be necessary to obtain a business loan. Think about what type of ownership you want. If you want or need a partner, select one carefully. Draw up a partnership agreement. Study the regulations which apply to the type of business you wish to start. Be sure to check the federal, state and county or city regulations.

If you are unsure about some area of business ownership, ask others who know. Areas such as insurance, taxes, record-keeping systems, and advertising may require outside assistance.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________________ **DATE:** ______________________

UNIT: Entrepreneurship

TOPIC: Starting Your Own Business

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to successful employment and/or postsecondary training.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of how to start a business.

REFERENCE: Student Information Sheet/Getting Started

DIRECTIONS: Have you ever considered having your own business? Do you think it would be easier or harder working for someone else? This activity will help you experience both the good and bad points of being an entrepreneur. First, consider your classmates as your business partners. Can you and your partners think of a product that can be sold in your school or perhaps a service you and your partners can provide for others? If so, you are on the right track to starting your own business and being an entrepreneur! Below is a list of steps to follow for small business success. You should realize, however, that if you were starting an actual business, there would be many more steps to follow.

STEPS FOR SMALL BUSINESS SUCCESS

1. Decide what type of product or service you will sell.
2. Decide approximately how many people you expect will buy your product or want the service you are willing to provide.
3. Decide if your are selling a product and whether you will make it or buy it from another company.
4. Decide what supplies will be needed to start your business.
5. Decide how much money will be needed to start your business.
6. Decide where you will get the money needed to start your business.
7. Figure the amount you will charge for your product or service in order to make a profit.
8. Decide when and where you will sell your product or provide your service.
9. Make sure that both the time and place you are selling your product or providing your service are convenient for others.

10. Agree on the name of your business.

11. Plan how you will advertise.

12. Decide how and who will keep track of the books. (inventory, money paid out, money taken in, etc.)

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: General Shop Safety

TOPIC: Personal and Group Safety

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to identify safe working practices.

Safety in the shop includes a knowledge of safety rules, proper attitudes regarding safety, personal safety, group safety, knowledge of clothing and personal protective equipment, and safe operation of equipment. Personal and group safety are good places to start when learning how **YOU** are affected by safe working practices.

Safety in simple terms means **FREEDOM FROM ACCIDENTS**. The Occupational Safety and Health Act of 1970 (OSHA) assures every working man or woman in the nation safe and healthful working conditions and the preservation of our human resources **(YOU THE WORKER)**. OSHA encourages the organization of accident-prevention programs in school shops.

In order to understand personal safety in the shop, you must develop a safe **ATTITUDE** about safety. A proper attitude is a must in any shop. Accidents do not happen by themselves. Most accidents are caused by thoughtlessness. It is important that you be alert while in the shop and be on guard against accidents at all times. Visiting should be avoided because it distracts from a person's alertness, which makes the individual accident-prone.

Personal safety involves protecting yourself from injury caused by your actions. By becoming aware of unsafe conditions and practices, you can protect yourself and others. When a number of individuals are working safely together you have **GROUP SAFETY**. This includes your entire class. Since every student's actions can affect someone else, it is important that **YOU** not only work safely, but that you stress the importance of classroom safety to your classmates.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME:________________________________ **DATE:**______________________

UNIT: General Shop Safety

TOPIC: Personal and Group Safety

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will be able to identify safe working practices.

REFERENCE: Student Information Sheet/Personal and Group Safety

DIRECTIONS: Read and complete each of the following statements about safety by filling in the blank.

1. In simple terms safety means freedom from______________.
2. You must develop a safe ______________about safety in order to understand personal safety in the shop.
3. Safety in the shop includes a knowledge of safety rules, proper______________regarding safety, ______________safety, group safety, knowledge of clothing and personal protective equipment, and safe operation of equipment.
4. Most ____________are caused by thoughtlessness.
5. The term OSHA stands for the ___________ ___________ and __________ __________ of 1970.
6. It is important that you be __________ while in the shop and be on guard against accidents at all times.
7. Visiting should be ____________ because it distracts from a person's alertness, which makes the individual _________-__________.
8. Personal safety involves protecting yourself from _____ caused by your actions.
9. By becoming aware of unsafe ______and ______, you can protect yourself and _______.
10. Since every student's _____can affect someone else, it is important that ______ not only work safely, but that you stress the importance of classroom safety to your _______.

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: General Shop Safety

TOPIC: Work Safety in the Shop

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will demonstrate a knowledge of safe working practices.

There are numerous safety rules which should be followed when working in the shop. These might be thought of as **SAFETY COMMANDMENTS**. Listed below are a number of safety commandments which will need to be followed while working in the shop.

SAFETY COMMANDMENTS

1. Avoid wrestling, throwing objects, and general horseplay.
2. Provide a place for everything, and keep everything in its place.
3. Keep your arms and back as nearly straight as possible when lifting heavy objects.
4. Never place objects on high places because they may fall and cause injuries.
5. Do not leave slippery substances on floors because they may cause people to fall.
6. Keep all work spaces clean of all materials to avoid stumbling or falling.
7. Remove or bend down all protruding nails to eliminate the hazard of their being stepped on or brushed against.
8. Notify your instructor of any known violations of safety rules or of conditions you think may be dangerous.
9. When loading trucks, always cross-stack the load at intervals .
10. Inspect ladders before use. Remove any faulty ladders from use.

    (**NOTE**: Never paint a ladder since paint can hide cracks or faults.)
11. When using a ladder, be sure the bottom rests on solid ground.
12. Be familiar with the correct methods of erecting a scaffold.
13. Replace faulty tools and equipment.

14. Immediately report all accidents and report for first-aid treatment.
15. Do not take chances!

Work safety in the shop also includes the use of proper clothing and protective equipment. Your clothes should fit well and be kept in proper repair. Ragged sleeves, neckties, or loose clothing may become caught in equipment, causing an accident or injury. While working in the shop, you should roll your shirt sleeves above your elbows and wear thick-soled work shoes for protection against sharp objects. When handling rough materials or sharp edges, always wear gloves. You can also protect yourself by wearing a hard hat or cap and by keeping your hair trimmed to avoid getting it caught in rotating machinery. It is important that you protect your eyes at all times. Be sure to wear safety goggles around abrasive, scraping, or sawing equipment. Protect your lungs by wearing a dust mask or respirator when working in dusty areas or spray painting areas.

Remember work safety in the shop protects you as well as those you work with.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________________ **DATE:** ______________________

UNIT: General Shop Safety

TOPIC: Work Safety in the Shop

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate a knowledge of safe working practices.

REFERENCE: Student Information Sheet/Work Safety in the Shop

DIRECTIONS: Carefully read the student information sheet "Work Safety in the Shop." Then read each statement below. If the statement is true, circle the "T"; if false, circle the "F."

T F 1. There is no harm in taking chances while in the shop.

T F 2. When using a ladder, be sure the bottom rests on solid ground.

T F 3. Notify your instructor of any known violations of safety rules or conditions you think may be dangerous.

T F 4. Place objects on high shelves to get them out of the way.

T F 5. Keep your tools wherever they are handy to you.

T F 6. Safety belts are not needed if the scaffold is erected correctly.

T F 7. Immediately report all accidents and report for first-aid treatment.

T F 8. Save faulty tools and equipment; you may need them.

T F 9. Remove or bend down all protruding nails to eliminate the hazard of their being stepped on or brushed against.

T F 10. Keep your arms and back as nearly straight as possible when lifting heavy objects.

T F 11. You should wear loose fitting clothing in the shop because it is more comfortable.

T F 12. Gloves should be worn when handling rough materials or sharp edges.

T F 13. Be sure to wear safety goggles around abrasive, scraping, or sawing equipment.

T F 14. You need only wear a dust mask or respirator if you will be working in a dusty area or spray painting area for a long period of time.

T F 15. Do not worry about wearing a hard hat or cap in the shop unless you are actually working.

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT:	General Shop Safety
TOPIC:	Fire Safety
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.
SPECIFIC OBJECTIVE(S):	After completion of this information sheet, the student will apply safe working practices and demonstrate a knowledge of fire safety.

Fire safety is an important aspect of general shop safety. Would you know what to do in case of a fire? Being prepared is an important part of being safe. In order to be prepared in case of a fire, you must first be aware of the types of fires you may encounter and how these fires are controlled.

Fire prevention is a form of fire safety. By practicing fire prevention, you may be able to avoid a fire in the shop. Shops should be kept clean and flammables stored properly. Look around your shop carefully so that you will know the correct way to leave the building in case of fire. If there is not a plan posted by the door of how to leave the building in case of fire, ask your instructor for these instructions. Be serious about fire drills because these may save your life.

If a fire should start in the shop, it is important that you know the location of the fire alarm. You should find out what materials are burning in order to know what type of fire it is. There are three types of fires; these are:

Class A--Ordinary combustibles such as wood, paper, or cloth.
Class B--Flammable liquids or grease such as gasoline, paints, or oils.
Class C--Electrical equipment such as motors and switches.

Putting out a fire is not as simple as using a fire extinguisher. There are different types of fire extinguishers, just as there are different types of fire. Below is a list of fire extinguishers, where to use them, and how to use them.

TYPES OF FIRE EXTINGUISHERS

Foam fire extinguishers are used on Class A and B fires. To use, turn extinguisher upside down and spray so that foam falls on the fire.

Carbon dioxide fire extinguishers are used on Class B and C fires. To use, squeeze handle, spray near the fire base and move upward.

Soda acid fire extinguishers are used on Class A fires. To use, turn extinguisher upside down and spray at base of the fire.

Water fire extinguishers are used on class A fires. To use, squeeze handle and spray at base of the fire. **(NOTE**: A water hose or bucket may also be used.)

Prevention is the best method of dealing with fire. Small or localized fires may be contained by using one of the fire extinguishers shown above. However, **BUILDING EVALUATION** will help assure your safety in case of a fire. Windows and doors should be closed when evacuating a building. (Someone should be assigned to do this.) Make sure everyone leaves quickly but in an orderly manner. Move away from the building, and wait for instructions from your teacher or other school personnel.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________________ **DATE:** ______________________

UNIT: General Shop Safety

TOPIC: Fire Safety

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will apply safe working practices and demonstrate a knowledge of fire safety.

REFERENCE: Student Information Sheet/Fire Safety

DIRECTIONS: Draw a sketch of your classroom and building. Include such details as hallways, doorways, fire escapes, windows, stairways, and other important features. Use a dark pen to draw dotted lines and arrows showing the best paths to take when leaving the building during a fire. Write any notes on the drawing that you feel might tell a person what to do or to expect during a fire. You may wish to look at your school evacuation plan posted in your classroom to see if it agrees with yours. At the bottom of your evacuation plan, list and explain the three classes of fire. Also list the correct types of fire extinguisher to be used for each and how they should be used.

COMMON
ESSENTIAL ELEMENTS

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: General Shop Safety

TOPIC: Safety with Hand and Power Tools

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to demonstrate skills in working safely and apply safety to the use of hand and power tools.

While working in the shop, you will have the opportunity to use hand and power tools. Before you attempt to use any type of tool, it is important that you learn to use the tools safely.

To simplify learning, we have divided the shop tools into two types: **HAND TOOLS**--those tools which are operated by hand, and **POWER TOOLS**--those tools which are operated by other sources of power such as electricity, gasoline, battery, compressed air, etc.

When working with any type of tool, you must focus your full attention on the work you are doing. Learn to use the tool correctly, and only use it for the job it is intended to be used for. You should have a place for each tool, and tools should be kept there when not in use. Tools work best when they are kept in their best condition. Be sure to clean tools after you use them, and sharpen tools as needed. Do not try to use a tool which has been broken or damaged.

When working with sharp-edged tools, be sure to cut away from your body. Keep tools away from the edge of a bench or work area. Injuries can occur from tools falling off of benches or work areas. Carry sharp-pointed tools with the point or cutting edge down.

There are special rules which must be followed when working with power tools. These include personal readiness along with a knowledge of power tool safety. Before operating any power tool, do a self-check. Make sure your hands are dry; remove ties, rings, or wristwatches; roll up long sleeves; and secure hair (tied back and under a cap). Listed below are steps to follow in operating power tools safely.

OPERATING POWER TOOLS SAFELY

1. Keep your attention focused on the work.
2. Know and understand all of the manufacturer's safety recommendations.
3. Be familiar with the operation procedures of the tools.
4. Inspect electrical cords to see that they are in good condition.
5. Power tools should be inspected and serviced at regular intervals by qualified repair people.

6. Be sure all power tools are grounded with three-wire conductor cord when required.
7. Do not leave electrical cords where they may be run over or damaged.
8. Make all adjustments and inspections with the power **OFF** and the cable **DISCONNECTED**.
9. Before connecting to a power source, be sure that the switch is in the **OFF** position.
10. Be sure that all safety guards are in place and in working order.
11. Wear safety goggles and a dust mask when the work requires.
12. Be sure that the materials to be worked are free of obstructions and are securely clamped.
13. Change in sound during power tool operation normally indicates trouble and should be investigated immediately.
14. When work is complete, shut off all power tools.
15. When work is complete, disconnect the power tools from the power source.
16. After the tools are disconnected, remove blades, bits, or any other cutter from the wood.
17. Store power tools and blades, bits, or other cutters in their proper places.
18. When the power tool is defective, remove it from service.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________________ **DATE:** ______________________

UNIT: General Shop Safety

TOPIC: Safety with Hand and Power Tools

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate a knowledge of the concepts and skills associated with safe working practices.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate skills in working safely and apply safety to the use of hand and power tools.

REFERENCE: Student Information Sheet/Safety with Hand and Power Tools

DIRECTIONS: Read each of the following statements regarding safety with hand and power tools. Circle the word needed to make the statement correct.

1. Hand/Power tools are tools which are operated by hand.
2. Hand/Power tools are operated by other power sources such as: electricity, gasoline, battery, compressed air, etc.
3. In working with any type of tool, you must focus your full attention/energy on the work you are doing.
4. Tools work only/best when they are kept in their best condition.
5. Before operating any power tools, make sure your hands are dry/clean/wet.
6. Make all adjustments and inspections of tools with the power on/off and the cable disconnected.
7. When work is complete, turn on/off all power tools.
8. Be sure all power tools are grounded with two-wire/three-wire conductor cord when required.
9. Do not/Do leave electrical cords where they can be run over or damaged.
10. Before connecting to a power source, be sure that the switch is in the off/on position.

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Human Relations and Personality Development

TOPIC: Terms and Definitions for Human Relations and Personality Development

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills associated with human relations and personality development.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to identify terms and definitions associated with human relations and personality development.

Below is a list of terms and definitions. Study these terms until you are comfortable in discussing what each one means.

1. **Ability**--the power or means to do something.
2. **Aptitude**--an ability that you have naturally; quickness to learn or understand.
3. **Attitude**--the way you act in a certain way to a given situation.
4. **Characteristic**--a quality about yourself which distinguishes you from others.
5. **Environment**--your surroundings.
6. **Interest**--something to which you give special attention.
7. **Leadership**--having those qualities needed to guide or direct others.
8. **Personality**-all the characteristics combined that make you the person you are.
9. **Trait**--a special quality that makes you an individual.
10. **Unique**--something that is completely different from anything else.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________ **DATE:** ______________________

UNIT: Human Relations and Personality Development

TOPIC: Terms and Definitions for Human Relations and Personality Development

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills associated with human relations and personality development.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will identify terms and definitions associated with human relations and personality development.

REFERENCE: Student Information Sheet/Terms and Definitions for Human Relations and Personality Development

DIRECTIONS: Complete the sentences below by using one of the following words. Then, locate the word used in the word find.

Ability
Trait
Unique
Leadership
Environment

Aptitude
Interest
Characteristic
Personality
Attitude

1. When you give something special attention, it could be said you have a(an) ______________ in it.

2. A special quality that makes you an individual is known as a(an) ______________.

3. Having those qualities needed to guide or direct others is known as ______________.

4. An ability that you have naturally is a(an) ______________.

5. All the characteristics combined that make you the person you are is known as ______________.

6. Your surroundings can also be known as your ______________.

7. The way you act in a certain way to a given situation is known as a(an) ____________________.

8. When you have the power or means to do something, it can be said that you have the ____________________.

9. When something is completely different from anything else, it is ____________________.

10. A quality about yourself which distinguishes you from others is a(an) ____________________.

S R Y U I V O P E D F V B W M I T G A C
E B A X U M K L N U B Q P R E C D T E B
C V B L E A D E R S H I P K M N O W I T
B U I M N O P W V B S R T P K T S C P O
Z Q I T M W K T I S O B D C A I W I E T
R K I R L V C M I N T E R E S T Q W R V
A I B A D K I P G T O M W U I C B C S L
Z P C I T U K F N G U C V K G N U Y O A
D W E T K I G H O P I D Q U H P E V N M
W B O Z G L M E T A S N E S O Z I Y A P
R B W C H A R A C T E R I S T I C Q L E
B A N K I O P E R I V X C W U O V Q I B
C B R I O U C P E N V I R O N M E N T S
O I N P T Y K U L M I O E S F R V B Y Z
V L U D G H Q W S V O B M S W I K N C N
S I X Q K I P A T T T I T U D E Q B K P
W T B E N W P R T Y K G B W D I N G K O
G Y B U C O T N G O M E K L S D A V E B
K E Q S E I V M C X W C S Q I Y R E W O
W S D C I G T W S I P V N I F E K G Y N

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Human Relations and Personality Development

TOPIC: Getting to Know Yourself

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills associated with human relations and personality development.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to demonstrate an understanding of the importance of getting to know yourself.

Why Understanding Yourself Is Hard to Do

Have you ever wondered why it is difficult to understand yourself? People as a rule are hard to understand. You are made up of many TRAITS and CHARACTERISTICS. If you are like most people, you most likely have not taken the time to appraise (evaluate) yourself. Each person has a different type of personality. Your personality is created by many factors. These include your family, your friends, your experiences, and your environment. You cannot compare the total you to anyone else--you are unique.

Relating Understanding Yourself to Career Choice

Being unique means that the career you choose will most likely be different from any chosen by your friends. Merely choosing a career because someone you know has that career does not mean that it will be the best for you. You need to be aware of your personal characteristics. Keep in mind both your good and bad qualities. Understanding yourself will play an important part in making a career choice that is best for you.

What About You Influences Your Career Choice?

Every individual has various qualities which influence his/her career choice. Self-concept is one of these qualities. Self-concept involves how you see yourself, how others see you, and how you would like to be. Lifestyle needs and work needs will play a part. Other aspects to be considered include personality, interests, abilities, attitudes, aptitudes, leadership traits, and the ability to change and/or accept change.

Understanding Yourself

There are many ways of learning about yourself. Tests have been developed which assess personality, interests, abilities, attitudes, aptitudes, etc. The better you understand yourself, the better you will be able to understand others.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME: ______________________________ **DATE:** ______________________

UNIT: Human Relations and Personality Development

TOPIC: Self-Concept Checklist

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills associated with human relations and personality development.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of self-concept.

REFERENCE: Student Information Sheet/Getting to Know Yourself

DIRECTIONS: Read each sentence carefully. There are no right or wrong answers. Just mark how you really feel about yourself. Y-Yes; N-No; NS-Not Sure.

__ I like myself.

__ I often get angry.

__ I can read fairly well.

__ People can depend on me.

__ I am a very shy person.

__ I get into lots of fights.

__ I am afraid of many things.

__ I am good in spelling.

__ I have many friends.

__ I tell the truth.

__ I look OK.

__ Sometimes I am clumsy.

__ I often feel sick.

__ I am good in arithmetic.

__ My handwriting is good.

__ I am successful most of the time.

__ Other people often laugh at me.

__ Most of the time I enjoy helping others.

__ I have a hard time making up my mind.

__ I like to be with my friends.

__ I am sad and depressed sometimes.

__ I would like to be someone else.

__ I like school most of the time.

__ I wish I lived somewhere else.

__ I am often nervous and upset.

__ I am good at sports and games.

__ Most people dislike me.

__ I am a happy person most of the time.

__ Other kids like to play with me.

COMMON ESSENTIAL ELEMENTS

1. Go back over your answers. Are you happy with the results? Are you happy about the way you feel about yourself? Are you happy about the way others feel about you?

2. Is there a pattern to your answers?

3. Will your answers influence the career you choose? Why or why not?

4. Would you change anything about yourself? If so, what?

5. How would you describe your self-concept?

6. If you have a negative self-concept, will it influence your ability to succeed?

STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Personal and Business Management

TOPIC: Terms and Definitions for Personal and Business Management

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of the concepts and skills related to personal and business management.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to identify terms and definitions associated with personal and business management.

Below is a list of terms and definitions. Study those terms until you are comfortable in discussing what each one means.

1. **Bank statement**--a report sent to the customer that includes a record of all deposits, a list of all checks that have been paid by the bank, all bank charges, and canceled checks.

2. **Canceled check**--a check that has been paid by the bank. The check is then returned to you with the bank statement.

3. **Certified check**--a type of guaranteed check; the bank stamps the personal check of a customer, then holds the amount of the check from the customer's account until the check is cashed.

4. **Collateral**--something of value held by a bank as security to guarantee repayment of a loan.

5. **Counterfeit bill**--money made by an individual but not approved by the U.S. government. You can tell the difference by holding a bill to the light. If the bill has blue and red thread-like lines in it, it is a genuine bill.

6. **Denomination**--value or size of a piece of money.

7. **Deposits in transit**--deposits that were recorded on the account holder's check register but were not processed at the bank in time to be included on the bank statement.

8. **Endorsement**--signature on the back of a check that allows it to be cashed or deposited.

9. **Gross National Product**--the total value of products that are produced in this country.

10. **Interest rate**--the amount of money charged for borrowed money; the amount paid to a depositor for money in a savings account.

11. **Inflation**--an increase in the amount of money and credit available to purchase goods, without an increase in the amount of goods available, resulting in a rise in the general price of goods.

12. **Loan**--money borrowed with promise to pay.

13. **Needs**--something that is necessary or required for your well-being.

14. **Overdraft**--the total amount of checks written on an account is more than the amount deposited into the account.

15. **Reconciling a** bank statement--another way of saying "balancing the checkbook"; process of getting the checkbook balance and the bank's balance to match.

16. **Serial number**--numbers on bills which identify them.

17. **Service charge**--fee charged by the bank for handling checking accounts.

18. **Signature card**--card on file at the bank that shows the signature of persons authorized to write checks on an account.

19. **Voiding a check**--tearing up a check that has been written incorrectly.

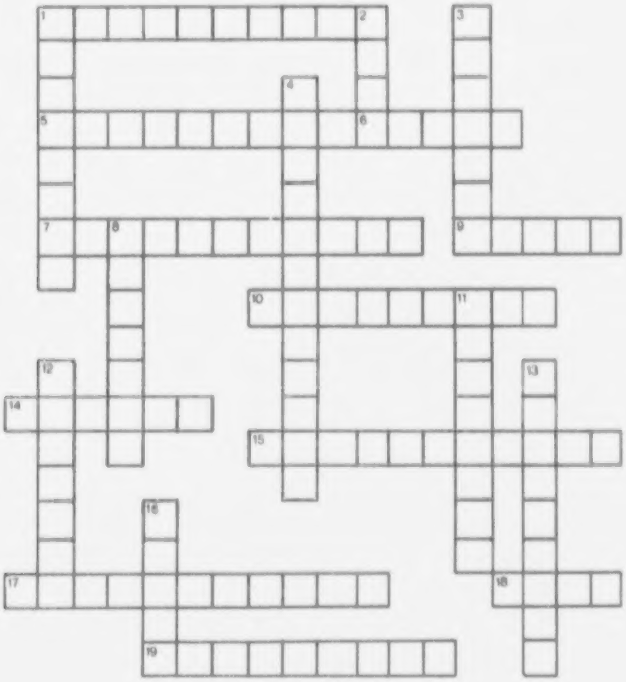
20. **Wants**--something a person has a strong desire for but which is not really necessary.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME:______________________________ **DATE:**______________________

UNIT:	Personal and Business Management
TOPIC:	Terms and Definitions for Personal and Business Management
UNIT OBJECTIVE:	After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to personal and business management.
SPECIFIC OBJECTIVE(S):	In completing this assignment sheet, the student will identify terms and definitions associated with personal and business management.
REFERENCE:	Student Information Sheet/Terms and Definitions for Personal and Business Management
DIRECTIONS:	Use the terms on Student Information Sheet/Terms and Definitions for Personal and Business Management to complete the crossword puzzle below.



Across

1. Something of value held by a bank as security to guarantee repayment of a loan
5. A type of guaranteed check
6. Something that is necessary or required for your well-being

7. Signature on the back of a check that allows it to be cashed or deposited

9. _______ National Product

10. Results in a rise in the general price of goods

14. Numbers on bills which identify them

15. Money made by an individual but not approved by the U.S Government

17. Another way of saying "balancing the checkbook"

18. _____ Statement--a report sent periodically to the customer

19. _____ Card--a card on file at the bank that shows the name and handwritting of the person authorized to write checks on an account

Down

1. A check that has been paid by the bank

2. Money borrowed with promise to pay

3. Tearing up a check that has been written

4. Value or size of a piece of money

8. A _____ in transit is one that has been recorded on the account holder's check register but was not processed at the bank.

11. Money charged for borrowed money

12. _____ Charge--fee charged by the bank for handling checks

13. The total amount of checks written on an account is more than the amount deposited into the account.

16. Something a person has a strong desire for

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STUDENT INFORMATION SHEET

COMMON ESSENTIAL ELEMENTS

UNIT: Personal and Business Management

TOPIC: Budgets

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to personal and business management.

SPECIFIC OBJECTIVE(S): After completion of this information sheet, the student will be able to demonstrate an understanding of budgets and how they work.

Need for a Budget

Before you begin the development of a budget, you should first understand why you need a budget. We all like for our money to go as far as it can. Budgets assist in making this possible. One reason for having a budget is to stop wasteful spending habits. Budgets help us to set goals for how we wish to use our money. By following your budget, you learn to live on the money you actually have. This allows you to establish a standard of living. Having a budget and knowing where you stand financially will help you in planning for the future as well as the present. Living within your budget allows you to set and achieve long-range spending goals.

Rules of Budgeting

In order to plan your budget, you should learn to recognize the difference between wants and needs. Arrange your spending goals in order of importance to you. While you are planning, set up some kind of savings goal. It's important to try to set aside a part of your income, no matter how small, in order to get into the habit of saving. Learn to think ahead and plan for the future. Keep in mind that you may need to be flexible. This may be necessary if income and expenses change.

Parts of a Budget

The parts of your budget will include income, expenses, and savings. Your income may be in the form of a fixed salary, what you know you will earn, or assumed wages, what you think you will earn.

Expenses may vary from month to month. Some expenses, such as car or house payments, will remain the same and must be paid at specific times. Other expenses, such as utility bills, charge accounts, etc., will go up and down.

The final part of your budget is savings. Savings goals may be classified as short-term, saving for something special like a tape, clothing, or weekend trip, or long-term, saving for a car, college, or getting married.

Planning a budget, regardless of how simple or complex it is, will assist you in reaching your financial goal.

ASSIGNMENT SHEET

COMMON ESSENTIAL ELEMENTS

NAME:________________________________ **DATE:**________________________

UNIT: Personal and Business Management

TOPIC: Budgets

UNIT OBJECTIVE: After completing this unit, the student will be able to demonstrate an understanding of concepts and skills related to personal and business management.

SPECIFIC OBJECTIVE(S): In completing this assignment sheet, the student will demonstrate an understanding of budgets and how they work.

REFERENCE: Student Information Sheet/Budgets

DIRECTIONS: Complete your own personal budget using the following information. You bring home $100.00 a month. You have the following expenses:

A. Divide your money among these expenses.

Food for lunches _____

Clothes _____

School supplies _____

Gifts _____

Entertainment _____

B. List any other ways you would like to spend your money.

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulations by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs or activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.